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## Contents.

| | PAGE |
|---|---|
| The Drift Southwards | 177 |
| A Means to an End | 177 |
| Correspondence | 178 |
| Proposals for Goodwill in Industry | 178 |
| Sheffield Metallurgist Appointed Director of Research | 179 |
| Reports and Dividends | 179 |
| Random Shots | 179 |
| Precision Castings | 180 |
| Book Review | 180 |
| New Foundry at the Vulcan Works of Ley's Malleable Casting Company, Limited | 181 |
| Contracts Open | 182 |
| New Blast Furnaces at the Old Works of the Stanton Ironworks Company, Limited | 183 |
| Chelsea Polytechnic's Classes in Metallurgy | 186 |
| Notes on the Routine Analysis of Cast Irons and Iron Foundry Raw Materials—No. 4 | 187 |
| A Magnificent Grille | 188 |
| Charging Blast Furnaces | 188 |
| Notes on Patternshop Management—IV | 189 |
| Iron in Antiquity | 190 |
| Weather and Supplies | 190 |
| The Machine Tool and Engineering Exhibition | 192 |
| Trade Talk | 194 |
| Personal | 194 |
| Company Meetings | 194 |
| New Companies | 194 |
| Obituary | 194 |
| Iron and Steel Markets | 196 |

**THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.**

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## Forthcoming Events.

SEPTEMBER 5-22.

*Machine Tool and Engineering Exhibition* at Olympia, London.

SEPTEMBER 13-14.

*The Ceramic Society*:—Autumn meeting in Glasgow of the Refractory Materials Section.

SEPTEMBER 14-16.

*Association of Special Libraries and Information Bureaux*:—Annual conference at New Oxford College, Oxford.

SEPTEMBER 22-27.

*Iron and Steel Institute*:—Autumn meeting at Bilbao.

SEPTEMBER 24-OCTOBER 6.

*World Power Conference*:—Fuel conference at Imperial Institute, London.

## The Drift Southwards.

Considerable comment has been made of late on the undeniable tendency of industry in Great Britain to drift southward, carrying prosperity with it, and various morals are drawn. One school of thought ignores the reason for the drift, resting content with such incontrovertible evidence as the low unemployment figure for London, and sees in the phenomenon a permanent transference of prosperity from the old-established staple industries to the newer developments. Certainly there is depression in the North, where we find coal-mining, ship-building, iron and steel, and cotton; and prosperity—or something approaching it—in the South, where the motor, electrical, and artificial silk trades flourish. These gloomy prophets explain the transference by pointing out how much of the former prosperity of our older industries depended upon the export trade, and how seriously that export trade has been diminished.

But it is necessary to look deeper and to discover the reason underlying this change of location. Industry has hitherto been obliged to keep within easy reach of the source of the power required—and so in England it sprang up first in the South where there were forests to supply charcoal, and subsequently shifted to the North in order to be near the coal supplies. To-day an important change is taking place. Industry is as much dependent on power as ever—if not, indeed, more so—but the dependence no longer involves proximity to the source of the power, since it is not the fuel itself so much as its product that is used. Thus, plant run by electricity need not consider the proximity of the pit-head in the way that proximity had to be considered by earlier plant run on coal. A further tendency in the same direction is the growing popularity of small-power units run by oil—which is, of course, a highly portable fuel—as a consequence of which small establishments are now able to spring up at a distance from the large towns, and, in addition, the agricultural use of power is encouraged.

Under such conditions various new considerations may be allowed to affect the choice of a site. Whatever the northerner may say to the contrary, the climate in the South can show certain advantages, and life there undoubtedly lacks some of the asperities of life in the North. A further influence working in the same direction is the desire on the part of certain of the older industries to make a "fresh start," free from the prejudices and traditions that are inevitable in the older industrial centres.

It is clear therefore that the drift southwards can be explained satisfactorily without recourse to the discouraging interpretation cited above. In fact, far from being a matter for anxiety it is rather matter for self-congratulation. Surely this attempt to adapt to new conditions and take advantage of new opportunities is a conclusive sign—if any were wanting—that vigour and enterprise are still characteristic of British industry, and that the reward cannot be long in coming.

## A Means to an End.

One of the most pathetic sights encountered in our great cities is that of a dull-witted person dressed in the height of fashion of the eighteen-nineties. So, too, in foundry practice, it is sad to encounter shops which were the acme of efficiency ten, twenty or thirty years ago. Sometimes the man who created this efficiency is still in charge and still proud of his handiwork. One listens with profound respect to the improvements he has achieved, but he is a brave man who would condemn the complete layout, equipment and management on grounds of obsolescence. Gradually one indicates the more recent developments in the correlation of the shop buildings to the economic movement of raw materials, work in progress and the finished article; the development of foundry plant and appliances; and finally the modern conceptions of an enlightened management. Obviously it is rare that one meets an individual who is mentally atrophied in all three directions, but it must be confessed that generally speaking weakness is exhibited in one direction. Quite usually this is derived from an assumption that no financial help is possible—an impression gained from numerous scraps of conversation with the "man that matters." Now if the foundry manager will bear in mind the three governing factors which demand his control—layout, equipment and management—and prepare and submit his schemes for their reconstruction or amelioration in the form of an annual report, it is obvious that only the following can happen: (1) The whole of proposals rejected; (2) partial acceptation; and (3) complete acquiescence. To our mind these desiderata are of the least importance; it is the cumulative effect on the industry as a whole which is our concern. The production of such an annual report by every foundry manager to his directorate or colleagues would do more to raise the general efficiency of foundry industry in five years than 50 years of natural haphazard development undertaken during periods of inflation or parallel expansion. We insist that every foundry manager worthy of the name should find time to initiate and prepare a scheme for the cheaper production of a superior product and submit it without asking and with progressive modifications to his chief at predetermined regular intervals.

XUM

## Correspondence.

*[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]*

### Problems in a Small Foundry.

*To the Editor of* The Foundry Trade Journal.

Sir,—First of all, let it be said that our firm, though small, is quite reasonably efficient in the manufacture of the goods it sells; the principals of the firm are thoroughly keen on the design and manufacture of the product, but are admittedly not so interested in the selling side of the business. The wages paid are high, and in exchange the production given by the workers is large. If it were possible to run full time regularly, sufficiently good returns would be obtained to enable the works to be expanded; more men could be employed who would have the opportunity of earning high wages, and these high wages in being spent would in crease the demands for other kinds of goods, with consequent further increases in employment.

But the trouble is to find enough work to keep even our small works fully employed.

Our product can be divided into two classes. Firstly, we make certain articles which are incorporated by other manufacturers in their product. We have specialised in these articles, and supply most of those used in this country. The part we make represents about 5 per cent. of the total cost of the article in which they are incorporated, and we cannot see that any reduction in our prices, and they are already much below pre-war ones, could make any appreciable difference in the price at which the finished product could be sold.

We therefore cannot see how any action on our part can be expected to increase to any extent the sale of these components.

Secondly, we make a very limited number of articles which are used in houses, and must therefore sooner or later be sold to the public. With one article we made arrangements with an expert in Mail Order distribution to undertake its sale direct to the public. The advertisements he inserted in various periodicals were in our opinions and in the opinions of our friends exceedingly attractive ones; we—doubtless being prejudiced—felt that they could not but attract attention, and, as the article was so obviously necessary in most houses, we got our stocks ready and waited for the orders to flood in as soon as the advertisements appeared.

The flood was hardly a trickle, in fact it was more like a series of disconnected drops. The selling campaign was a fiasco; each reply received to the various advertisements cost half as much again as the value of the article we were selling. Obviously selling by the mail order method was a failure as far as our product was concerned.

If we had a large range of articles to sell, it might be possible to sell direct to retailers. But it is quite certain that calling on individual retailers is a very expensive matter when the range of articles to be offered is small, and orders for large numbers of any item are unlikely. Obviously our product ought to be distributed by wholesalers, if wholesalers have any real justification for their existence. But this is the burden of the song of the wholesaler: "We could not dream of touching it if any other firm were selling it as well. We certainly could not undertake to take any definite number—any orders we received we should pass on to you. Of course we must have a big margin between what you charge us, and the retail price; it is so expensive selling to retailers and there are so many bad debts," and so on. The margin that the wholesaler and retailer wants is so high that the final result is that an article for which we get, say, 10s., which we trust, after all the contingencies of manufacture are allowed for, will include a reasonable profit for us, is finally sold to the public for 25s., or rather the public is asked to pay 25s. for it, and probably refuses.

What we should like to know is whether our experience of the distributing trades is quite exceptional. If it is not, one is inclined to harbour very hard feelings about those who come between the manufacturer and the public in the chain of distribution. Does it seem reasonable that the tradesman who buys an article and sells it over the counter should get anything like the same return to cover the cost of this simple transaction and his profit as does the manufacturer who has made the article—bought the material, employed the labour, had numerous operations done on the material and packed and despatched the finished product?

Why *is* selling so expensive? It appears to us that the real answer is an exceedingly simple one. The average person in this country is too poor. It is probably much harder to sell a Rolls-Royce to a cotton spinning mill owner than it was in 1919, and in the same way it is hard to sell even a second-hand push-bike to a miner who has been unemployed for a couple of years. If all persons employed in industry and commerce were next week to have their wages doubled, the cost of selling would enormously decrease. An absurd suggestion, of course, and not very helpful, but the point is this. At present we are in a vicious circle; low earnings—small purchasing power—high cost of selling—high retail price of goods—small demand for them—fewer workpeople employed—still lower earnings and so on. Shortly after the war there was a great outcry for industry to "Produce More." Industry has produced more; wholesale prices for most of the products of industry have been lowered to extremely reasonable figures—and we have still our unemployed and workpeople on short time who would only be too delighted to "Produce More" if they had the chance. Now the slogan should be for the benefit of the distributing trades—"Sell More." And they can only do so and break this appalling vicious circle which is keeping our country from prosperity by reducing their prices and increasing their turnover.

Are too many people trying to make a living out of the distributing side? Is the margin between what the producer receives and what the consumer pays a reasonable one on the average, or is it so large as to handicap the producer unduly in his efforts to find regular employment for his workpeople? Or are these assumptions all wrong, and is it the fact that we do not spend enough on selling?

Of course, the fact may be that the small firm is doomed, that unless a firm is large enough to be able to conduct widespread advertising campaigns on behalf of its products, it cannot expect to survive. If this be so, it seems to be another defect of modern civilisation. Our impression is that very many big firms, although they have all the latest methods and machines available, are not quite as efficient as they might be. The feeling which the writer had when he was employed by a large firm immediately after the war was that very little energy was used in getting things done compared with that expended in getting permission to start trying to get something done. There seemed an overpowering mass to move before the smallest alteration could be made. It may have been necessary—co-ordination is a blessed word—but it did not encourage initiative.

What does appear clear is that in very many cases a small firm can make experiments in a way impossible for a large one. The failures are on a small scale and not too important, while the successes can be adopted generally. Surely it is not a disadvantage to the country for there to be a continuous small stream of new firms starting in the old industries, and it is very hard for a new firm to start satisfactorily on anything but a small scale. In fact it is doubtful if many kinds of business ever can start on a large scale unless they are able to draw the bulk of their organisation from some other firm of which they are the offspring.

Our final words to anyone who is in a regular position with a good firm and thinks of starting his own manufacturing business are these. Unless you value independence above most things, certainly above a regular income and an absence of worries, then stay where you are. If independence seems almost everything to you, even then, think many times before you take the final step. The difficulties you will be up against are certain to be quite twice as great as you have anticipated even in your most pessimistic moments. And whatever happens, be absolutely certain before you

(*Continued on page* 179.)

## Proposals for Goodwill in Industry.

### B.C.I.R.A. Director Honoured by Scottish Association.

An interesting ceremony took place on Tuesday, September 4, in the Library of City Chambers, Glasgow, when Mr. J. G. Pearce, M.Sc., M.I.E.E., Director of the B.C.I.R.A., received there an award of 100 guineas for a series of practicable proposals for promoting goodwill in industry. The award was presented by the Lord Provost of Glasgow, Sir David Mason.

As has been previously indicated in our columns, the prize was offered by the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen. The second prize of 50 guineas, contributed by Sir Daniel M. Stevenson, was awarded to Mr. Robert Allan. The third prize of 10 guineas was divided between Mr. J. Williamson and Mr. J. Butler. A special prize of 10 guineas confined to members of the Association was won by Mr. Allan Andrews.

The presentation ceremony took place before a gathering of prominent Clyde leaders of industry. Subsequently the party was entertained to tea by the Lord Provost.

In the absence of the President of the Glasgow Association, Mr. Walker, through illness, the Vice-President, Mr. J. M. Miller, introduced the subject, saying that all right-thinking men recognised that the day of strikes was over and that settlement must necessarily be by compromise.

Mr. James Vance, a past-president of the Association and chairman of the Goodwill Committee, briefly outlined the history of the scheme. They believed that the Glasgow Association was in a unique position to promote industrial harmony, standing as it did between masters and men. Following the greatest strike the country had ever known, the leaders of both sides in industry were greatly exercised as to the future outlook, and it was recognised that co-operation and goodwill should be translated into practice. The Association appointed a representative committee to investigate the problem of goodwill between capital, management and labour. The Committee set to work to invite contributions from firms, individuals, employers, managers and workmen and also from kindred organisations as well as Trade Unions and welfare supervisers and others engaged in industry. They also set to work and collected and collated literature dealing with the subject. The prize essay scheme was next formulated and to-day's ceremony represented the climax to that part of the work. It now remained to review the information received to write a report on the whole subject, giving the considered views of the Committee, which would be issued for publication with the prize papers. The Committee was now engaged on this final task of sifting the information received.

The Lord Provost then formally handed the prize to Mr. Pearce with a few congratulatory remarks, and after the other prizes had been presented Mr. Pearce was called upon to speak on behalf of the whole of the prize winners.

Mr. Pearce said that his interest in the essay competition was aroused when he saw a letter from the society to a London daily advising that Sir Archibald Denny and Mr. J. T. Brownlie had consented, with Mr. John Holloway, to act as judges. He thought that any scheme which would appeal to men of such reputation for fair mindedness and yet of such widely differing training, experience and points of view, must be likely to appeal to industry in general.

The problem of industrial goodwill had interested him for many years. He found it necessary to earn a living before he could create the opportunity of having a university course, and he had thought a great deal about the subject of industrial understanding during some fifteen years industrial experience since leaving college, dating from the days when he spent a lengthy apprenticeship on the floor of the shop and foundry, earning a very few shillings a week as an apprentice.

The problem which faced British industry was peculiar to this country; it arose partly from our conservatism and industrial traditions, and partly from the acute independence and individualism in point of view, which showed the British worker at

once to be the most intelligent in the world and in some respects the most difficult to get to work in a team. He had found the German workman, and indeed the Continental workman generally, far more willing to do exactly as he was told without asking why, and to this trait, together with a gift for organisation which enabled their managers to make it easier for their men to do the right thing than the wrong thing, a good deal of the success of our Continental competitors must be attributed. In America, class distinctions were not understood, and the worker was none the less a man because he was not an employer. He put out his best and was well rewarded. Anglo-Saxon leaders were to a large extent responsible for American prosperity. Mr. Pearce was convinced that in settling this problem in this country, there was no necessity to appeal, and that it was even harmful to appeal to sentiment. The right sentiments will follow and not precede action. We must cultivate in British industries the attitude of mind that we now too exclusively reserved for sport.

Finally he thanked the donors most cordially on behalf of all the prizewinners and congratulated the Glasgow Association on its courage and enterprise in striking out a new line which rendered it unique among the technical associations in this country. The amount of talk about goodwill in industry during the past ten years had created a fog in which many groped in vain. He believed that he spoke for all the prizewinners when he said that no mere money prize would have persuaded them to put in the time and energy required to complete the task. The problem was not what to put in, but what to leave out. The driving force was the hope, which they trusted would not be vain, of making a contribution, however small, from practical experience, to the solution of a problem which more than any other affected the future of the British Empire. Our power for good in the world was conditioned by our ability, literally and metaphorically, to "deliver the goods."

Our surest satisfaction would come in the assurance that the winning essays would receive the widest possible publicity and honest attempts to try the recommendations made in actual practice without prejudice. This could be done, to some extent, by everybody in industry, for it required effort on the part of all co-partners in industry, and not merely by the employer. The greatest enemy of goodwill was apathy, indifference and the passive acceptance of conditions as we found them.

Sir Daniel Stevenson said that he felt strongly that they had in the Covenant of the League of Nations an example which ought to be followed in our industries. If international disputes were to be referred to arbitration, should not national difficulties be settled in the same way? He had written in that sense to the Press of Glasgow, London and Manchester, and also to the I.L.P. Then came the general strike. He felt that the prize winning essays would be of tremendous weight in leading to settlement. Mr. J. W. Kempster, a member of the Goodwill Committee, proposed a vote of thanks to the Lord Provost, who suitably responded.

## Correspondence.

### Problems in a Small Foundry.

(*Concluded from page* 178.)

start that you are going to be able to sell your products. Unless you have this certainty stay where you are. Do not say to yourself that as yours will only be a small show it will be quite easy to keep it full of work. It does not follow at all. If you are to be efficient in spite of being small, the range of work you will be able to do will be limited, and you will find it just as hard or harder to sell your output of this limited product as a larger firm to sell its larger output of a more varied product. And if in spite of all these warnings you decide to strike out on your own, then the very best of luck to you.

Yours, etc.,

FOUNDRY OWNER.

## Sheffield Metallurgist Appointed Director of Research.

As recently announced, Mr. George Batty, a Sheffield metallurgist, has been appointed research director to the Steel Castings Development Bureau, 500, Stock Exchange Building, Philadelphia, Pa.

Mr. Batty received his technical education at the Sheffield Technical School, which later became part of Sheffield University. For eleven years he operated in the capacities of steel maker or works manager with a number of Sheffield companies, engaging in the manufacture of tool steels and special steels by the crucible and electric processes.

MR. GEORGE BATTY.

After spending five months in 1920 in Detroit, Michigan, in a consulting capacity, with the Ford Motor Company, he returned to Great Britain and entered upon the production of steel castings.

Early in 1923 he was appointed works manager of the National Steel Foundry, Limited, Leven, N.B., and later became technical director of that company. During the latter part of 1927 and in the early months of the present year he operated as a steel foundry consultant in Detroit, Michigan.

The Steel Castings Development Bureau is associated with eight foundries, who are financing an investigation of the manufacture of steel castings with a view to improving the quality of the product, and so making available to engineers components of a quality superior to those now in commerce.

## Reports and Dividends.

**Clarke, Chapman & Company, Limited.**—Interim dividend of 3 per cent., less tax, on the ordinary shares.

**Wm. Roberts (Tipton), Limited.**—Balance at credit of profit and loss account, £1,853; brought forward, £2,455; one year's dividend on the cumulative preference shares to March 31, 1926, less tax, £1,680; carried forward, £2,628. The furnaces still remain idle. The advisability of restarting has again been constantly under consideration, but the difficulties attending the manufacture and sale of pig-iron have been so acute that the directors have been forced to the conclusion that to have done so would have resulted in serious financial loss.

THE CZECHO-SLOVAK SKODA COMPANY has been authorised to open a branch at Moscow and a consignment depôt at the works of the Soviet concern Orgametall. The only other Czecho-slovak iron and steel firm to have a permanent branch in the Soviet Union is the Witkowitz Works.

## Random Shots.

Some day the march of scientific invention may enable us to be in two places at one time, but at present it is impossible, even for so faithful a chronicler of foundry interests as "Marksman" to be in more than one place at once; hence his inability to report personally upon some of the meetings which have taken placed during the past week, and which demanded a passing record.

* * *

Among these was the opening of the Machine Tool and Engineering Exhibition at Olympia, and the British Association Meeting at Glasgow, at which Sir William Bragg's Presidential Address dealt with science and craftsmanship, about which we shall have something to say on a future occasion. At the moment we would like to mention the extraordinary increase each year in the publicity which the meetings of the British Association get in the daily Press. It was the exception rather than the rule to find a morning paper which did not give a leading article on this Address.

* * *

Another interesting function at which it would have been pleasing to assist, in the French sense, or, as the Scot would put it, to have been a "'chiel' takin' notes," was the presentation to Mr. J. G. Pearce of the first prize in connection with the "Goodwill in Industry" competition, from the hands of the Lord Provost of Glasgow. I understand that a number of very prominent industrialists from the Clyde were present, and that further developments are likely to follow.

* * *

Apropos of this question, I can hear the cynic asking whether further talk can do any good when we look at the spate of solutions which have been given us during the last few years by politicians, journalists, accountants, and others who do not find themselves responsible for productive enterprise.

* * *

One of the difficulties, however, of this age of universal education is that the horse, while perfectly capable of engaging in that sequence of labial and laryngeal motions which we call drinking, cannot be forced to drink. People can read, but they either cannot or will not; if they do it makes little or no impression.

* * *

However, we resisted the blandishments of the British Association and fell victim to the wiles of the Institute of Metals at Liverpool, the president of which is Dr. Rosenhain, of the N.P.L. This meeting was quite well attended, and very enjoyable, thanks to the efforts of a strong local committee. The Lady Lord Mayor, Miss Beavan, made a very favourable impression in welcoming the Institute to the city, and the three papers on die-casting, at any rate, as I hinted last week, provided a discussion of first-rate foundry importance. The evening lecture by Mr. F. G. Martin dealt with those enemies of the metallurgist on marine work—sea water and fuel oil. Reference was also made to the development of new condenser tubes alternative to brass.

* * *

Why is it that Liverpool should create a much more favourable impression on the casual visitor than its rival, Manchester? Is it that little extra freshness in the air from the river or that feeling of spaciousness which is given by St. George's Square?

* * *

Pleasant and friendly as have been the meetings, we must confess that they lacked those delightful little touches which often send an audience into a roar at the I.B.F. Conventions. When people presume to address us in public we feel that they must be very superior persons, and perhaps we subconsciously resent the implied superiority. When a speaker makes a palpable slip, as is not infrequent at foundry meetings, the audience dissolves into a roar and forgives the speaker, for he turns out to be clay like themselves. The rather more highbrow speakers I have heard this week do not give us the same opportunity of claiming kinship.

MARKSMAN.

# Precision Castings.

**By Edgar H. James.**

Precision or accuracy is a matter of degree, and in engineering processes it is necessary to establish arbitrary limits or standards of accuracy applicable to particular operations, and commensurate with the importance of the operation in its relation to the final product. Whatever the limits of accuracy established for any one particular purpose the term precision implies that these limits are adhered to with strict uniformity. In its application to castings the term precision has come to have a real meaning as a result of the development and extension of the various die-casting processes during the last few years. The die-casting processes have been responsible for the production of many castings to a degree of accuracy hitherto unobtainable with sand castings, and in many cases to sufficiently close limits as to enable machining operations to be dispensed with entirely. Apart from the many products of more or less domestic application, a vast number of miscellaneous parts used in electrical machinery, switchgear, wireless apparatus, typewriters, motor cars and engines, and even cinema cameras and projectors almost essentially depend for their economical production on the application of die castings.

The progressive demand for precision castings is primarily brought about by the modern developments in large-scale production. The economy of all the processes and methods adopted in large-scale production is vitally affected by the character of the initial raw material. Machining operations carried out on special-purpose tools require castings to precision limits. The extension of the use of grinding methods creates an insistent demand for castings to within grinding limits, and precision limits are vitally necessary in eliminating the waste and cost of the raw material. On the other side large-scale production methods create for themselves the most important condition necessary to the successful production of precision castings in the shape of large demands for castings off the same pattern. It is this condition which finally determines the possible outlay on special tools and apparatus necessary in the foundry to obtain the desired accuracy and uniformity in the castings.

### Competition from Die-Castings.

In the case of die-casting processes a permanent metal mould, prepared to the desired degree of accuracy, is the fundamental necessity of all the various processes, and all die-casting processes depend for their success on the use of this form of permanent mould, which lends itself to careful preparation to the desired standard of excellence, and allows of the repetition production of castings from the one or master mould. In the case of a suitable casting required in quantities which satisfactorily liquidate the cost of the die, the process of die casting can be made to operate highly successfully from an economical point of view, and to rival in point of costs the cheapest form of sand casting. This in addition to the precision results.

Amongst the various limitations which surround the die-casting process the most important is probably that of its limitation to the lower melting point non-ferrous alloys, and the light aluminium alloys in particular. Whilst considerable progress has been made in its application to the copper-rich non-ferrous alloys, its predominant application is the light aluminium alloys, and, whilst it may be true to assert that the aluminium alloys have made the die casting, it is almost equally true to say that die casting has made the aluminium-founding industry. The limiting features in the extension of these processes to the higher melting-point alloys, more particularly cast iron, with which we are presently concerned, are the higher molten-metal temperatures and their behaviour on subjection to the more rapid cooling in metal dies.

In so far as cast iron is concerned, this latter is of vital importance, for unlike other industrial alloys, cast iron when subjected to rapid cooling is converted into a hard, white, unmachinable variety, commonly referred to as chilled, and which can only be removed by annealing. The higher liquid-metal temperatures involved present quite a wide variety of technical difficulties. It becomes no longer a simple matter to maintain and continuously handle small quantities of metal, such as cast iron, at temperatures round about 1,300 deg. C. These higher temperatures are also ultimately responsible for prohibiting the use of metal cores, and so far as the writer is aware no really satisfactory use of metal cores has been made. Sand cores are almost invariably used where permanent metal moulds have been adopted for cast iron. The higher liquid-metal temperatures result in the more rapid deterioration of the die material, and these factors have been the principal causes in prohibiting the development of die casting in all but certain special and isolated cases, as a method of the production of precision castings in cast iron. Many attempts have been made to overcome these various difficulties, and whilst in certain cases some success has been obtained, it cannot yet be said that die casting of cast iron is an accomplished fact.

### Precision Cast-Iron Castings.

The demand for precision castings in cast iron has been met in rather a different manner by the extension of precision methods of operation to the ordinary sand-casting processes. Whilst the degree of accuracy obtained is not quite comparable with die-casting processes, there can be no doubt that the degree of precision is equally as satisfactory in all respects. Quite a wide variety of castings are being produced by precision sand-casting methods accurately to within what, to-day, are regarded as commercial-grinding limits, viz., 0.03 in. Such castings as motor-car pistons and sleeves are typical examples. The peculiar internal shapes of petrol-engine combustion heads demanded by designers to conform with certain requirements of the character of the explosive mixture in the cylinder are produced accurately and with precision to even closer limits, and it is now no uncommon thing to find iron-foundries equipped with surface tables on which the outgoing castings are checked and inspected to accurate gauges, and to fine limits of dimensions and relations of various parts.

The ability to adapt sand-casting methods to the production of precision castings is an index of the magnitude of the progress made during the past few years in all the details of foundry progress. The production of precision castings calls for tool-room methods in the manufacture of the patterns, and the transmission of this accuracy to the finished mould affects every detail of the foundry operation. In endeavouring to select one aspect of the improvements in foundry processes as an illustration, our choice must naturally fall upon the use of oil-sand methods. Although the use of oil sand in itself does not constitute the whole art of the production of precision castings, it is one of the most important of the features of modern foundry practice which has rendered it possible. From many points of view our hopes of continued improvement in our methods are pinned to the use of oil sand.

### Oil Sand Cores and Precision Work.

In all its aspects the successful use of oil sand lends itself to precision working. Pure natural silica sand is the base, and in its preparation a definite quantity of the oil binder is added and thoroughly mixed under definitely standard conditions. The drying of the moulds and cores is likewise effected under definitely standard conditions, which must of necessity be continued from day to day with uniform accuracy. All these conditions and circumstances of its preparation allow of a certainty of uniformity in the results being established, which is, of course, one of the necessary conditions in the production of uniformly accurate castings.

The properties of oil sand, of strength, ease of venting, refractoriness allow of fine duplication of the intricacies of many types of castings, and the stability and rigidity of the dried material allows of its use for the moulds in addition to cores. The extension of this practice has had a great influence in the successful production of precision work.

Exactly as in the case of die-casting processes using permanent metal moulds, quantity production is essential to ensure the success of precision work in the foundry. The preparation of the patterns or core boxes needs to be carried out mostly in metal with the same degree of accuracy as in the production of dies. The assembly of the moulds, either in moulding boxes or jig fixtures, requires accurately-machined work to maintain the accuracy of assembly of the mould parts. All this expensive preliminary preparation necessitates quantity requirements to liquidate the costs, and to put the production costs on an economic basis.

Castings to-day are required more and more to meet the competition of alternative methods of production, such as drop forgings and stampings, and one of the principal directions in which this competition can be resisted lies in the more extensive production of precision castings, and developments in precision methods in the foundries. There can be no doubt that as the methods at present in use in many places become more widely known and practised, that progress which is so necessary to continued prosperity in the foundry industry will be rapidly made.

## Book Review.

**Das Geschütz im Mittelalter**, by Bernhard Rathgen. — Published by the V.D.I.-Verlag G.m.b.H., 40, Dorotheenstrasse, Berlin, N.W.7. Price 50 Reich marks plus postage.

This beautifully-presented volume dealing with artillery in the middle ages is the life work of the late General Bernhard Rathgen. The author has made an intensive study of his subject over a long period of years, and has drawn freely upon the archives of the older cities of Germany. The book contains nearly 750 pages, and is divided into 55 chapters. The 56 illustrations have all been relegated to the end of the book and reproduced on 14 plates. The bibliography is admirable, whilst the index is extremely complete. One of the most interesting features is a chronological table noting the developments in artillery progress from the catapults or stone slingers used in about the year 2000 B.C. to 1450 A.D., by which date the use of cast-iron balls made it possible to reduce the bore of the guns. The main text of the book, however, only deals with the 14th and 15th centuries.

The book may be characterised as an authentic standard work on the subject which will always be consulted by those interested in the development of guns and mortars.

The author's chronological table ends with the year 1450. This may account for the omission of all mention about the large Turkish guns used at the siege of Constantinople in 1452. Foundrymen would have been interested in the description of "how the big gun was cast," given in the biography of Mehemet II, by Kritobulos of Imbross. One monster gun was used by the Turks in 1445 when the Papal fleet attempted to prevent the crossing of their army from Asia Minor into Rumite (European Turkey). The gun fired stone balls of prodigious size, which "put up the wind" of the Commander-in-Chief of the Christian fleet, who did not disguise his fear to his cousin, Jehan de Wavrin, the Burgundian chronicler. His fears were quickly allayed as the gun burst after a few shots. One hit from it would have sunk his ship to the bottom of the Bosphorus by the sheer impact of the projectile, says the Chronicler. There are many interesting particulars about cast-iron guns and how they were nursed to prolong their lives in the works of the Neo-Greek writers, like Khalko-Kondylas, etc., that would interest the modern foundryman.

# New Foundry at the Vulcan Works of Ley's Malleable Casting Company, Limited.

The Vulcan Works, Derby, of Ley's Malleable Casting Company, Limited, are the largest of their type in Europe, occupying an area of upwards of 30 acres, and it is somewhat remarkable that during the several years of acute depression in our manufacturing industries extensions to the works and plant have been constantly in progress.

The manufacture of a malleable casting is a highly scientific proposition in which perhaps progress generally in this country has not been very consistent; too often operations have been governed by a rule-of-thumb method which, giving a definite effect, has been standardised, with the inevitable result that for the most part malleable castings have not advanced in line with the more exacting requirements which advances in general engineering practice have imposed upon them.

Ley's Malleable Casting Company are, however, amongst the notable exceptions. By maintaining a very close and, one might say, friendly relationship between the laboratory, the testing department, and the foundry a high degree in excellence of manufacture has been attained and is being maintained. It is claimed for Ley's "Black Heart" malleable iron that it has no superior the world over, and in support of this it may be noted that deliveries last year exceeded 10,000 tons. The following physical tests speak for themselves:—

(1) On a round bar 0.66-in. dia.: Yield point, 15 to 17 tons per sq. in.; ultimate tensile strength, 22 to 26 tons per sq. in. (average 23.7 tons per sq. in.); elongation on 2 in., 10 to 18 per cent. (average 14.5 per cent.). The averages stated were taken from tests made on every heat over a long period.

(2) On a bar 1 in. × ⅜ in.: Cold bent round, 1 in. dia., 170 deg. to 180 deg. without fracture.

(3) On a notched bar 10 mm. × 10 mm.: Impact test, 8 to 11 ft.-lbs.

Generally speaking, it is not possible to make extensions of any magnitude to an existing foundry without sacrificing more or less the continuity of operations, and consequently the overall efficiency of the foundry. The latest extension at the Vulcan Works, Derby, therefore, takes the form of an entirely self-contained foundry, with the exception of the sand-mixing, which is done in a central plant serving the whole of the foundries.

The new foundry has been particularly laid out to deal expeditiously with those parts which lend themselves to mass production, and thus to relieve congestion in the other foundries. It occupies a building 360 ft. long × 165 ft. wide, which is covered with a concrete roof of terrace form, the sides of each terrace being windows; the sides of the building itself are also liberally lighted, and the whole of the windows are made to open, each row being controlled by a single chain from one point. The foundry is heated by exhaust steam from the power house, which is adjacent.

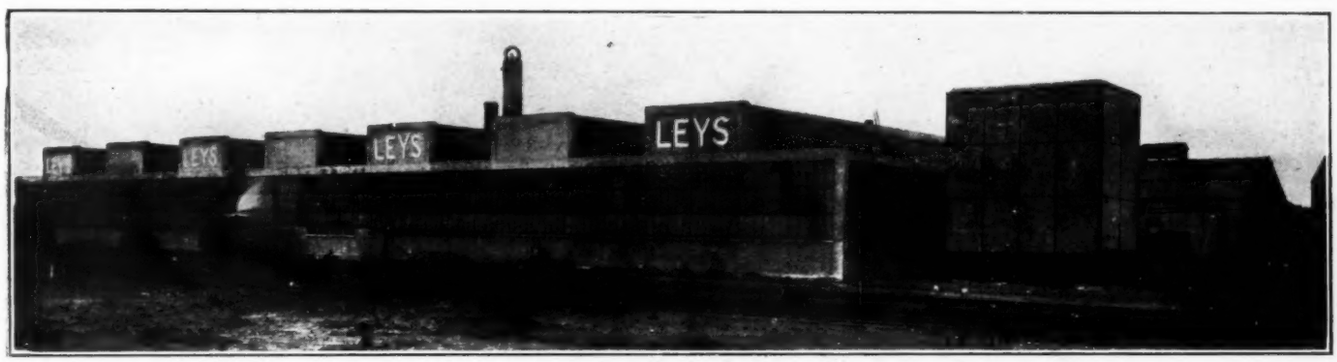



FIG. 1.—VIEW OF THE NEW FOUNDRY AT THE VULCAN WORKS, DERBY, OF LEY'S MALLEABLE CASTING COMPANY, LIMITED.

FIG. 2.—PART VIEW OF ONE OF THE REVERBERATORY FURNACES, SHOWING WASTE-HEAT BOILER IN REAR.

The building comprises three bays, the centre bay (in which the furnaces are housed) being served by two Herbert Morris 5-ton cranes. The other bays are served by five Royce 1-ton cranes with transporter system, this last serving to deliver the castings from the foundry to the dressing or machine shops, as the case may be.

As previously stated, the sand-preparing shop is common to all the foundries; it is placed in a central position and is directly connected up to the railway sidings, so that new sand can be discharged direct from wagons on to the mixing floor. The used sand is barrowed from the foundries to the shop and tipped down a shute feeding an elevator which delivers into a revolving sieve with ¼-in. mesh, the through sand passing on to the mixing floor and the over size being delivered through a magnetic separator which is built into the delivery end of the revolving screen. By this system about 2 tons of metal are recovered per week. From the mixing floor the sand is fed into one of the two pan mills, afterwards being aerated, and is then barrowed back to the foundries.

The elevating, screening and magnetic separating plant were supplied by the Rapid Magnetting Machine Company, Limited. The complete plant is driven through belts from a 31-h.p. motor.

To revert to the new foundry, one-third of the floor space is served by four travelling sand slingers, whilst ranged round the walls of the building are six combined jolt and squeeze machines and 46 air-squeeze machines, these last being mainly used for flask work. The whole of the machines will take boxes up to 18 in. × 14 in.

### Melting Plant.

The melting plant consists of two reverberatory furnaces, each to bring down a charge of 25 tons. They are each fitted with four spouts, two at the bottom and two above the bottom. The pig-iron is weighed as it enters the foundry on an Avery dial weigh platform of 5 tons capacity. The charges are loaded into 3-ton trays, which are handled by one of the cranes, the furnaces being charged in two or three places according to the weight of the charge to be brought down. The furnaces, which are placed back-to-back, are used alternatively; they are fired with pulverised fuel from the central supply. Apparently there is little if any economy resultant from the use of the pulverised over solid fuel in the reverberatory furnace, though by the use of the first-named it is practical to employ a furnace of considerably greater melting capacity than would be possible were solid fuel employed. The surplus heat from the furnace is used for steam raising; such use of the surplus heat from the reverberatory furnace is a distinct novelty in this country, though we believe it is practised to some extent in America. A Stirling waste-heat boiler is installed, with an evaporative capacity of 17,500 lbs. per hour at 200 lbs. working pressure, which is superheated to a total temperature of 600 deg. Fah. The gases are drawn through the boiler by a Sirocco fan, which is driven by a B.T.-H. motor of 21-h.p. The pull of the fan is controlled by the chimney damper so as to maintain a balance. The gases enter the boiler at a temperature of 1,500 deg. C. and finally the flue to the chimney at a temperature of 300 deg. C. Two steam-driven Weir pumps are installed for boiler feeding, one standing by. A W.R. $CO_2$ recorder is in service. It will thus be seen that the foundry is responsible for raising a large volume of steam per hour without any expenditure upon fuel; as obviously the furnace temperature must be maintained, and were the surplus heat not used under the boiler it would pass to the chimney as waste heat.

The steam raised is used to drive a W. H. Allen turbine, 6,500 r.p.m., which is coupled

through gearing to the Mather & Platt 300-kw. generator, 3-phase, 50 periods, 410 volts, at 1,000 r.p.m. The exhaust is dealt with in a P.B. evaporator and atmospheric condenser.

The pulverised fuel installation, which was carried out by Fraser & Chalmers' Engineering Works, is the largest of its kind in the British Isles. Not only are the melting and annealing furnaces fired with pulverised fuel, but it has also been applied for firing three Lancashire boilers with entire success. This is particularly interesting, as it is, we believe, the first application to a Lancashire boiler which has proved successful without the use of a cumbersome combustion chamber, the burners in this case being applied direct to the front of the furnace. The burner imparts a swirling form to the flame, thus eliminating all blow-pipe effect. This practical demonstration of the possibility of using pulverised fuel under the Lancashire boiler will be of considerable interest to colliery managers and engineers, particularly in view of the number of dry-cleaning plants which are being installed, as it will enable them to turn to profitable account a material the disposal of which has hitherto been a difficult problem.

Fig. 3.—One of the Sand Slingers in Operation.

The Fraser & Chalmers' Holbeck system of pulverised fuel firing has previously been dealt with in our columns; it will be sufficient, therefore, in this article if we outline the application of the system at the Vulcan Works. At the outset we would point out that only slack of the highest grade is employed; in point of fact that is the first essential if the best economy with pulverised fuel is to be obtained. It is only at the colliery where the use of a low-grade fuel is justified.

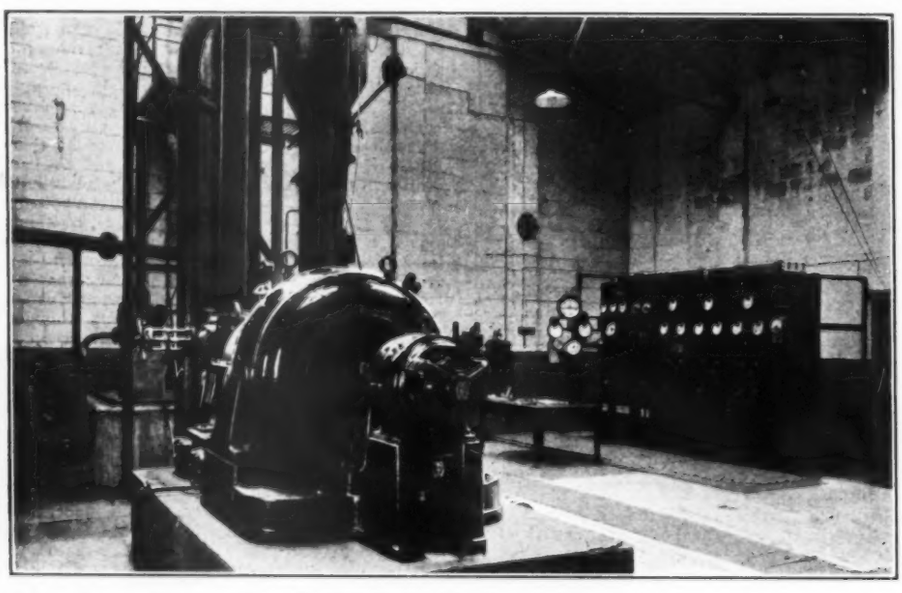


Fig. 4.—View in the Power House.

The coal is tipped from wagons down a shute, which feeds into a preliminary crusher of the roll type. The duty of this crusher is very light, as it does no more than break down any large lumps which may come over with the slack. The crusher delivers on to a shaker conveyor, which passes beneath a magnetic separator for the removal of tramp iron, and feeds the slack into a bucket elevator, from which it is discharged into any one of the three silos, two of which each have a capacity of 350 tons; the third silo, of 250 tons capacity, is placed immediately above the dryer. In addition to receiving the slack direct from the preliminary crusher, this silo is fed from the main silos by the bucket elevator.

The dryer is of the vertical type, fitted with suitable baffle plates, and is heated by a coal-fired furnace, giving a temperature of approximately 350 deg. Fah. within the drying chamber. In this dryer the moisture is reduced from 8-10 per cent. down to 4 per cent., the dried coal is fed by conveyor into the pulveriser, which is driven by a 50-h.p. motor, and has an output capacity of 2 tons per hour. A fan working in closed circuit delivers the pulverised fuel into the storage bin of 55 tons capacity, which is placed above the supply mains. The outlet from the storage bin is controlled by ten feed screws, each serving a separate main and each driven by a 1-h.p. variable-speed motor, the control of the motors being by rheostats at the various points of consumption.

Fuel is conveyed through the mains to the melting furnace by a Sturtevant fan driven by a 50-h.p. motor, a second similar fan acting as stand-by. The mains for the annealing furnaces, etc., are served by one of two fans, which work in a closed circuit.

The elevators, conveyors, and handling apparatus in connection with the pulverising plant were supplied by the Ewart Chainbelt Company, Limited, Derby.

## Contracts Open.

**Constantinople,** September 20.—Iron and steel girders for roofs, for the State Railways and Ports Administration. The Department of Overseas Trade. (Reference A.X. 6789.)

**Hampton,** September 17.—Supply and erection of 1,100 yards of unclimbable iron fencing, gates, etc., for the Urban District Council. Mr. S. H. Chambers, surveyor, Public Offices, Hampton.

**Johannesburg,** October 26.—Cast-iron specials and lapwelded steel pipes (approximately 2,475 ft. of 28¼-in. external diameter), for the Electricity Supply Commissioner. The Department of Overseas Trade. (Reference A.X. 6720.)

**Johannesburg,** October 11.—Galvanised, barb and steel wire, etc., for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.X. 6775.)

**London, S.W.,** September 14.—Steel rails and fishplates, for the South Indian Railway Company, Limited, 91, Petty France, Westminster, S.W.1.

**London, S.W.,** September 17.—Girder bridge spans for the Madras and Southern Mahratta Railway Company, Limited, 25, Buckingham Palace Road, S.W. (Fee, £1 1s., non-returnable.)

**London, S.W.,** September 17.—95 tons of structural steelwork, cast-iron piping, etc., for the Madras and Southern Mahratta Railway Company, Limited, 25, Buckingham Palace Road, Westminster, S.W.1. (Fee, £1 1s., non-returnable.)

**London, S.W.,** September 17.—95 tons of structural steelwork, 599 steel tyres, and 85,300 fishbolts, for the Madras and Southern Mahratta Railway Company, Limited, 25, Buckingham Palace Road, Westminster, S.W.1. (Fees, £1 1s., £1 1s., and 10s. 6d. respectively, non-returnable.)

**Port Elizabeth,** September 27.—500 6-in. diameter cast-iron pipes, 9 ft. lengths, 500 3-in. diameter cast-iron pipes, 9 ft. lengths, and 250 4-in. diameter cast-iron pipes, 9 ft. lengths, for the Municipality. The Department of Overseas Trade. (Reference A.X. 6750.)

**A Combination Ladle Nozzle.**—The Joseph Dixon Crucible Company, Jersey City, N.J., U.S.A., have put on the market a new ladle nozzle. The upper half of this is of super-refractory clay and the lower half is graphite. It is claimed for this nozzle that the metal can leave the ladle at a much lower temperature than is the practice generally, and so a more perfect ingot is poured.

# New Blast Furnaces at the Old Works of the Stanton Ironworks Company, Limited.

What are known as the Old Works of the Stanton Company were laid down in 1850, the plant consisting of four blast furnaces and their necessary auxiliaries. The furnaces, which have been dismantled to give place to the plant under notice, were each capable of producing from 350 to 400 tons of pig-iron per week. Obviously it was not possible to make any drastic modifications to the furnaces themselves, but the auxiliaries have been modified from time to time, and, as a matter of fact, were well in line with the best modern practice. The old pipe stoves had given place to 10 modern Cowper stoves, and the blowing engines had been replaced by turbo blowers. Calcining, however, was still being done in clamps.

The existing buildings have been utilised without interfering in any way with the general scheme of the layout, which provides perfect continuity and economy of operation. Indeed, the plant of the Old Works is representative of all that is best in modern blast-furnace practice, and in its entirety is equal, if not indeed superior, to any works of a like nature in the kingdom.

The blast-furnace plant—which was designed, manufactured and erected by Head Wrightson & Company, Limited, Thornaby-on-Tees, in collaboration with the respective officials of the Stanton Iron Company—consists of three blast furnaces with down-comers, dust-catchers, inclined chargers, scale cars, coke bunkers, ore bunkers, calcining kilns, wagon hoist, and wagon drop.

The time taken by Messrs. Head Wrightson & Company for the completion of the wagon hoist, eight kilns, wagon drops and one furnace, complete with the mechanical charging equipment, was less than one year, and the remaining two furnaces with full equipments were completed three months later—this despite the fact that for about two months of this time the builders were handicapped by the miners' strike. It is worth noting that this constitutes not only a British but a world's record.

Of the furnaces, the first to be erected was at the New Works, and as this forms the first part of a scheme of reconstruction, we will confine ourselves in this article to a consideration of the installation of the two furnaces at the Old Works, the construction of which is complete.

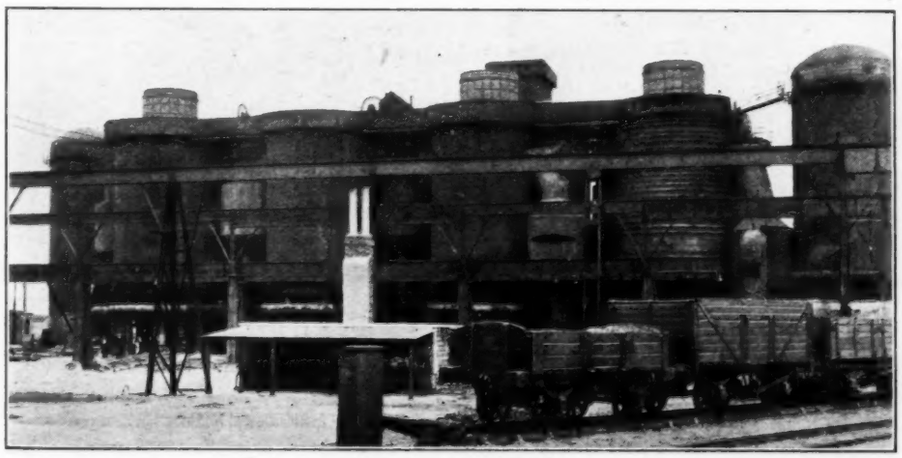


FIG. 1.—VIEW OF OLD FURNACES BEFORE DEMOLITION COMMENCED.

The furnaces have 11-ft. hearths, 19-ft. diam. boshes, 13-ft. diam. throats, 9-ft. diam. bells, and are 75 ft. high to the charging level. They are designed to make 1,000 tons of iron per week working on Midland ores containing an average of 28 to 30 per cent. of iron. As a matter of fact, the furnace at the New Works, which has been in blast since January last, is regularly making between 1,000 and 1,100 tons weekly of foundry iron.

The furnace casings are constructed of $\frac{5}{8}$-in. and $\frac{3}{4}$-in. mild-steel plates fitted to built-steel entablature girders and carried on eight columns, of a compound section, supported upon a grillage. The top tier of each casing is made conical and fitted with a cast-steel seating ring to take the main hopper, and also with specially-shaped brackets for supporting the top platform, charging and distributing gear.

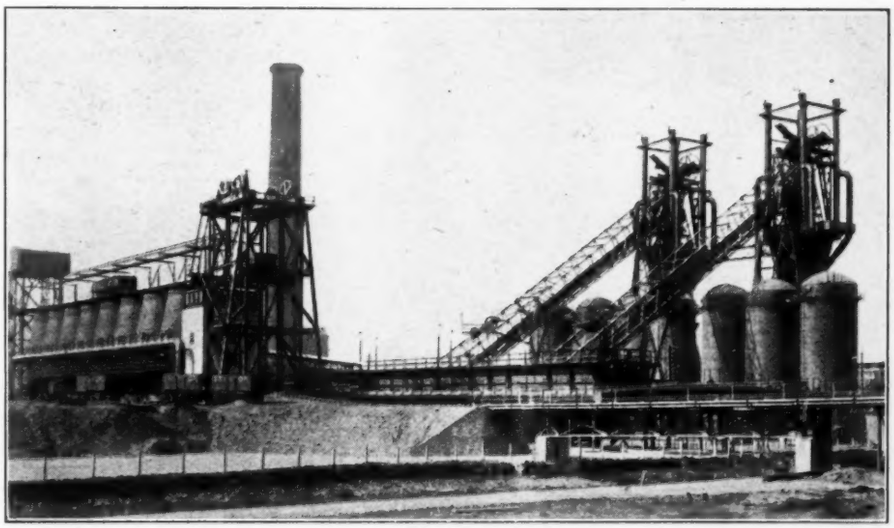


FIG. 2.—GENERAL VIEW OF NEW BLAST FURNACE AND CALCINING KILNS.

The hearth jackets are made of $1\frac{1}{4}$-in. mild-steel plates, butt-jointed with double covers, having ample provision for the tapping holes and slag notches. Each jacket is fitted with eight water-cooled cast-iron housings for the main tuyere coolers, with eight flat hearth coolers between them.

The circular hot-blast mains are 3 ft. 6 in. inside diam., with branches for connecting to the tuyere pipes. Each main is connected to the hot-blast main by two inlet branches, each having a hot-blast valve to enable the furnace to be isolated.

Eight sets of cast-iron tuyere pipes are fixed to the branches on each circular hot-blast main. They are fitted with swivel joints, sight holes, doors, belly pipes and connections, and are controlled by the valves on the inlet to the mains. The tuyeres are of copper fitted in copper coolers, which are in turn a machine fit inside the water-cooled housings on the hearth jacket. The cooling water is supplied to the tuyeres, tuyere coolers, flat hearth coolers, and bosh casings by circular cast-iron mains suspended from the bosh casings.

The bosh casings are made of $\frac{5}{8}$-in. mild-steel plates, butt-jointed with single-butt straps, double-rivetted. The plates are in one length vertically, with flush rivets on the outside, and a water trough around the bottom. The casings are hung from the entablature girders with strong angle rings riveted around the tops. Sprays are fitted and fed from the water mains suspended around the casings.

Each furnace is provided with a working platform with sloping bridge over the metal and slag roads to the pig beds. The platforms are made of mild-steel plates supported by channels fixed to the furnace columns, having curb angles on all edges, so that the platforms can be covered with brick or other material. Hand-rails are provided around the outside, together with a stair-case at each side to give easy access from the ground.

At the left of each tapping hole is mounted a J. M. Ringquist and Head Wrightson & Company, Limited, patent mud gun. This gun is suspended by a bogie running inside a traverser which in turn is carried by a swinging jib operated by two single-acting pneumatic cylinders. The first of these cylinders swings the jib with its gun from the stowed position to the front of the tapping hole, in which position the jib is automatically locked. This operation only takes up part of the stroke of the cylinder, the remainder being used to advance the gun into firing position in the tapping hole. The maintenance of pressure in this cylinder holds the gun in position during firing and dispenses with holding-in gear. The second cylinder is used for withdrawing, slewing and stowing the gun.

*Down-comers and Dust-catchers.*—The gas is taken from each furnace by four vertical tubes 3-ft. diam. fixed around the top conical tier of the furnace casing, each being of sufficient height to be used as a "candle," and having a suitable valve controlled from the working platform. From the sides of these vertical tubes or "candles," at a point about 20 ft. up, 3-ft. diam. down-comers are led down the sides of the furnace in pairs, each pair being merged into one tube of about equal area, *i.e.*, 4 ft. 6 in. diam., which are led to the dome of the dust-catcher. The tops of the "candles" are carried up above the rope sheaves and well braced together by means of a platform, access to which is obtained by a ladder from the sheave platform.

The dust-catchers are 20 ft. diam., supported on girders and columns, each being fitted with a butterfly valve and four explosion doors on its dome and a dust-outlet valve at the bottom. A platform fixed around the top of the parallel portion of the casing gives access to the explosion

doors. On the top of the butterfly valves on the domes are fixed 6-ft. diam. gas-connection boxes, with 6-ft. diam. connections to the main gas tube.

*Furnace-Top Equipment.*—The furnace tops are of the double-bell and revolving distributor type, and are designed to permit of easy and expeditious changing of the large and small bells and hoppers, and also to minimise and distribute the load over the furnace casing, both during normal working or while changing the bells or hoppers. The main hopper is supported on a seating ring on the furnace casing having a mild-steel conical cover bolted to its top flange. This cover is provided with explosion doors, also a gas seal at the top of the cone for the revolving distributor. The bell for the main hopper is of cast steel 9 ft. diam., and is suspended from its bell beam by means of a rod and flat-link chain giving a vertical movement of the bell.

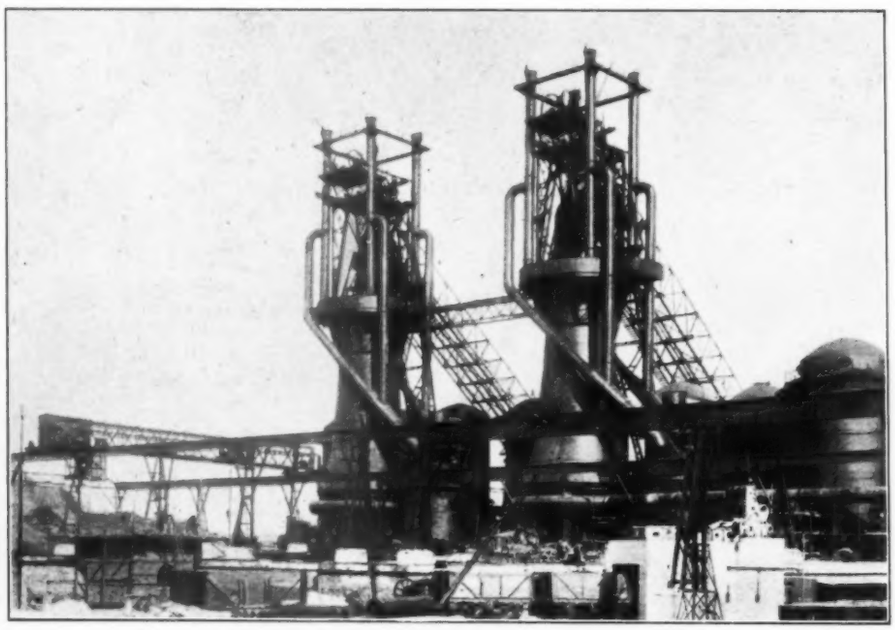


Fig. 3.—Front View of New Blast Furnaces.

The revolving distributor is 5 ft. diam., with a gas seal at the lower end to engage with the one on the conical cover, and vertical and horizontal rollers and roller paths at the upper end. Rotation of the distributor is effected by a motor through gearing, the final reduction being a pinion and rack. The distributor is closed by the small bell suspended from two bell beams by means of a tube encircling the main bell rod. This tube is connected to the beams by a cross-head with rods and flat-link chains. The beams are arranged one at either side of the main bell beam and are connected together at the back end so that they can be operated together by one rope. All the bell beams are carried on a fixed steel superstructure, which is also used for suspending the runway girders for the bell-changing gear, to be described later.

A "Y"-shaped receiving hopper is fixed above the rotating distributor for receiving the discharge from the skips. It is secured to a traverser running on track girders fixed to the top platform at either side of the large hopper seating ring and at right-angles to the charger bridge. The rollers, motor and gearing for the rotating distributor are also secured to a platform on this traverser.

The traverser, which is of mild steel designed to provide maximum rigidity with minimum weight, is fixed over the centre of the furnace during normal working and bolted to the track girders. During the operation of changing a bell or hopper the weight of the traverser is taken by four adjustable cast-steel trod wheels, attached one at each corner for running on the track girders already referred to. Removal of the main bell and hopper is effected as follows:—The bell will be supported by a beam passed through a hole at the top of same. The lower connection of the main bell suspension rod is broken above the receiving hopper. The bolts connecting the conical cover over the large hopper, also those securing the traverser to the track girders, are removed and the traverser, together with the whole of the furnace-top equipment above platform level, moved to one side, leaving ample space for handling the bell or hopper. A runway girder is suspended from the fixed superstructure of the bell beams and is provided with a set of block and tackle with hand-operated traversing gear which is capable of handling the main bell or hopper. The traversing gear is stationary and operated from the furnace platform. A portable hoisting winch is installed on ground level for lifting out the bell or hopper and lowering it to the ground.

The above operation is reversed for the replacement of the bell or hopper as required. It will thus be seen that no dismantling of the furnace-top equipment is necessary for changing a bell or hopper, the whole of the receiving hopper, distributor, rollers, driving mechanism, gas seal, etc., being removed and replaced bodily by means of the traverser, thereby reducing to a minimum the time required for this operation. The whole of the furnace-top equipment is supported by the furnace, and no rigid connection is made between this and the charger bridge. The large and small bells are operated independently by means of wire ropes, reeved over conveyance sheaves on the charger bridge to separate electrically-driven winches at ground level.

*Inclined Chargers.*—As Mr. R. Sharp (general blast-furnace manager to the Stanton Company) points out, there is a considerable divergence of opinion regarding the use of the bucket as against skip charging. In America the skip system predominates, whilst in Germany the bucket type is the most popular. In this country both types have found equal favour. Mr. Sharp having had experience of the bucket type found the following weaknesses:—Even filling of the buckets impossible. The buckets have to be attached to and detached from the hook at the bottom of the furnace charger, which is by no means an easy operation and necessitates attention. The system involves a lot more rope equipment on the charging apparatus proper. The tub or bucket system usually means a heavier type of charging apparatus consequent upon a slower rate of operation. These defects Mr. Sharp considers are eliminated by the use of the double-skip hoist. The skips being permanently attached to the ropes, there is a straight haulage from the winch to the skip, and, what is more important still, the distributor at the top of the furnace is as nearly mathematically correct as it is possible to obtain in furnace charging. The use of a double skip eliminates waits, and is thus labour saving, whilst it is better balanced than the single skip and lends itself more easily to a system of automatic control. These were the considerations which determined the adoption of the double skip at Stanton.

The skip bridges are constructed of mild-steel plates and rolled sections strongly braced together. They are supported on a concrete foundation at the lower end, and on an independent trestle at the upper end. Each bridge is provided with double tracks extending from the bottom to the tipping point of the skip cars. A stairway is fixed up the side of the bridge from the ground to the hoisting-sheave platform having a flexible connection to the furnace top. The skip cars are each of a capacity of about 140 cub. ft.; they are hoisted by twin ropes with equalising gear. The skip-hoisting gear consists of a grooved drum to take twin hoisting ropes. The driving motor is mounted upon the same bedplate as the drum and reduction gearing. The motor is of the shunt-wound protected type. All the bearings are ring oiling, and the gearing cast steel, with the teeth cut from the solid, the first reduction running in an oil bath. The main hoisting ropes

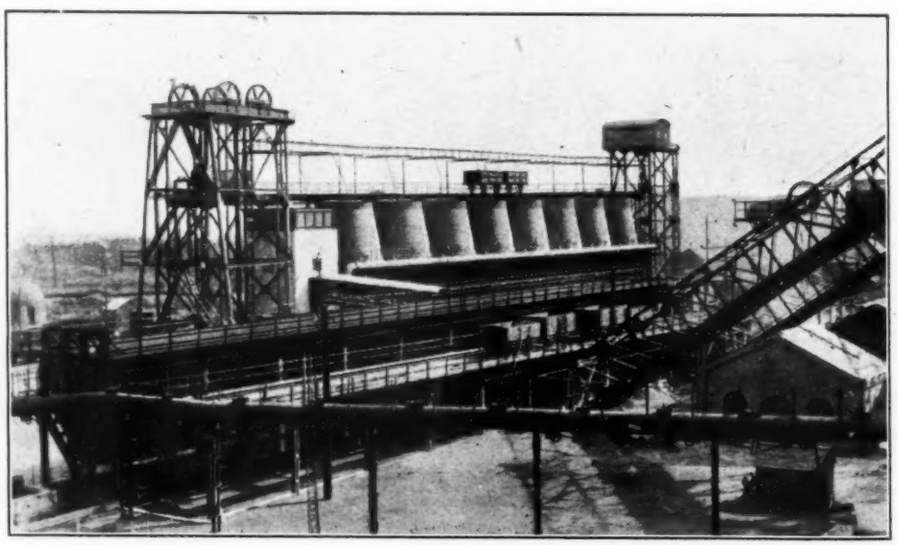


Fig. 4.—View of Coke and Ore Bunkers and Calcining Kilns.

after leaving the head sheaves pass over conveyance sheaves at the same point on the charger bridge as those from the bell beams, and then to the hoisting machinery at ground level. The hoisting machinery, bell-operating gears, and control gear are housed in a brick building under the charger bridge.

*Control Equipment.*—Contactor control gear is provided for the control of the skip hoist, distributor and bell-operating mechanism, and is designed to give complete automatic control of the hoist, distributor and bell operations by a push-button operated by the scale-car operator.

The distributor drive is arranged to take three skips with the distributor stationary, three skips revolved 60 deg., three skips 120 deg., three skips 180 deg., three skips 240 deg., and three skips 300 deg., the operation being as follows:—After the operator has filled a skip car he presses the push-button and the skip ascends and stops at the furnace top by means of limit switches operated by the control gear in the machinery house. After an interval the skip is started on the return journey at the commencement of which a limit switch is operated which energises the solenoid at the master controller for the distributor and bell motors.

The movement of the distributor is controlled by a secondary controller, and as it comes to rest it starts up the small bell motor, which discharges into the main hopper and closes the small bell again. Before this motor stops it energises the master controller so that as soon as its operation

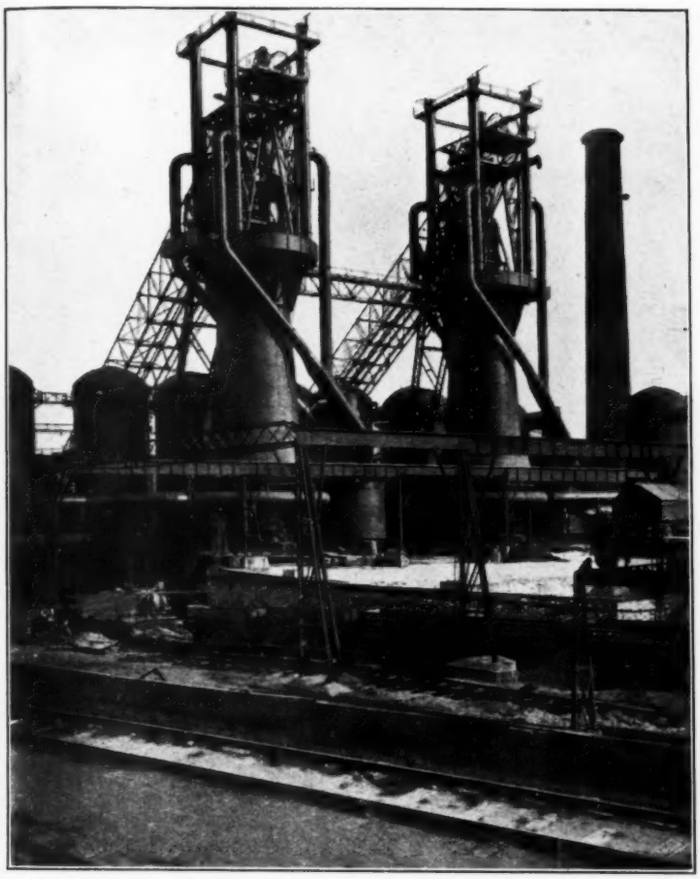


FIG. 5.—VIEW OF NEW BLAST FURNACES FROM PIG BED.

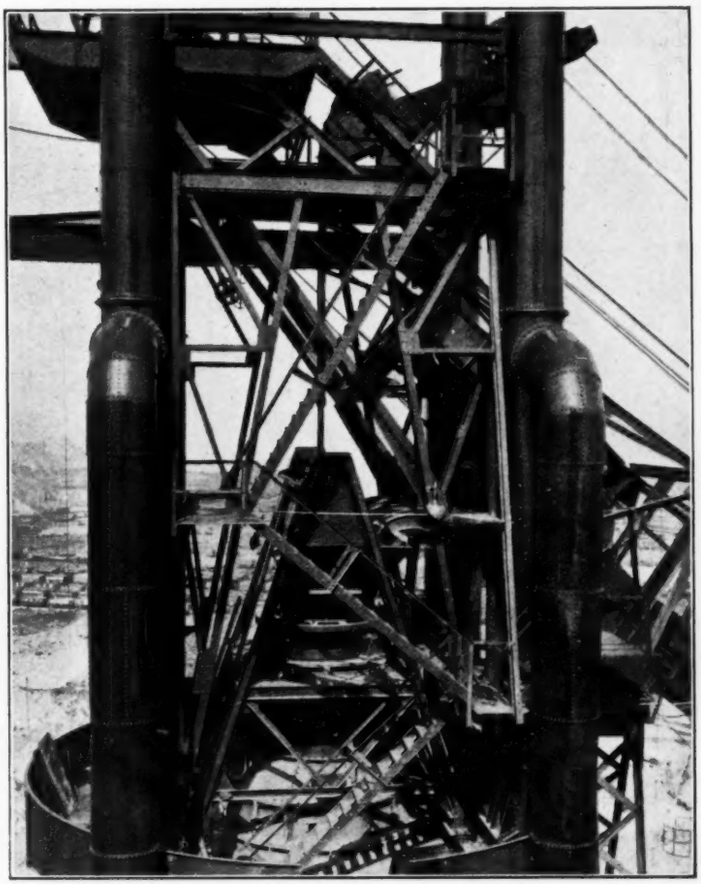


FIG. 6.—VIEW OF FURNACE TOP.

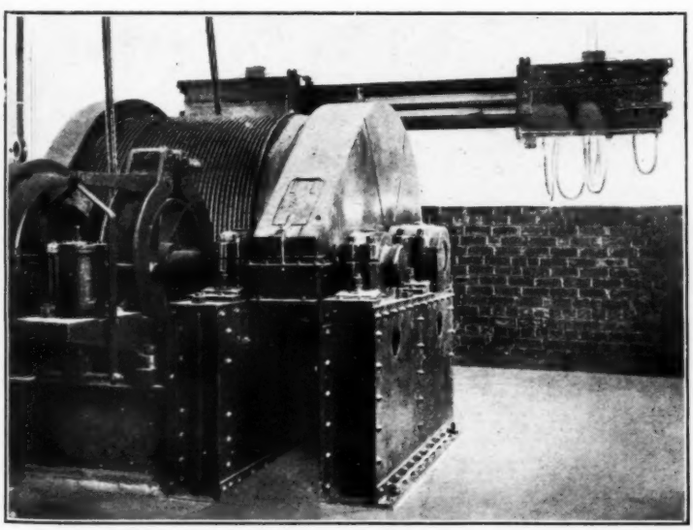


FIG. 7.—VIEW IN MACHINERY HOUSE SHOWING WINCH AND LIMIT SWITCHES.

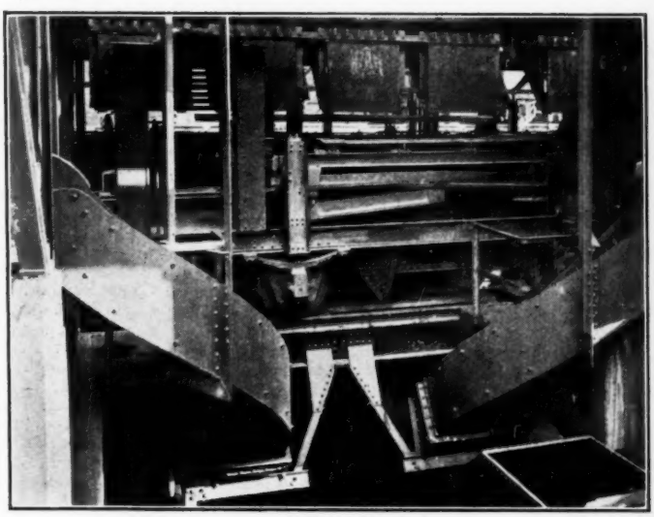


FIG. 8.—VIEW IN SKIP PIT.

is complete the scale-car operator can press the start button and again send a skip car on its journey. Bell motors are so arranged that the small bell opens after every skip and the main bell after every third skip, the controls being interlocked so that only one or the other bell can be opened at one time. The operations of the bell motors are so arranged that if an obstruction occurs whereby a bell is prevented from closing, its motor is reversed and the bell again opened to its full stroke, and it will continue to open and shut until the obstruction clears itself. The bells when closed are sealed by an automatic contrivance whereby undue strain is not imposed on the ropes and suspension rods, and yet the object of sealing the bells absolutely tight is definitely accomplished.

*Test Rods.*—Two test rods are provided on the top of each furnace to indicate the height of the burden. They are connected to a pneumatic ram situated in the machinery house, which in turn is electrically-operated once during each cycle. The rods are timed to be withdrawn just before the main bell is opened, and after it is closed to automatically lower and indicate to the scale-car operator the height of the burden on an indicator board conveniently placed at the foot of the hoist.

*Scale Cars.*—The scale cars are electrically-driven and used for conveying ore and limestone to the skips. The cars are of standard gauge and of the bottom-discharge type; they have a capacity of 160 cub. ft. and are equipped with weighing machine and automatic recorder to weigh up to 5 tons by 56 lbs. The discharge doors are operated from the control cabin by a hand wheel and gearing.

*Ore and Coke Bunkers* are situated at the foot of the hoist, one at either side of the scale-car track, which runs at right-angles to the charger bridge. The shutes of the ore bunkers are fitted with discharge doors operated by pneumatic cylinders. The coke bunkers discharge direct into the skips by means of spiral shutes.

*Calcining Kilns.*—There are eight calcining kilns which stand on the site formerly occupied by the calcining clamps. The kilns are of the Clarence type, similar to those described in our columns in connection with the C Furnace at Port Clarence. The kilns are served with a gantry over the top and furnished with a wagon hoist at one end and a wagon drop at the other. The gantry consists of a single track with a gradient of 1 in 80 and a footway and handrail at each side. Each kiln stands upon a solid brick foundation built up to rail-level and finished inside a ridge of cast-iron plates above to form the bottom of the kiln. The kilns are gas-fired and are fitted with the Priest system of induced draft by Priest Furnaces, Limited, Middlesbrough. Each kiln is capable of dealing with 1,000 tons of raw ore per week, so that they will take over the full duty for both the New and Old Works.

The wagon hoist is capable of lifting a 30-ton wagon from ground level to the top of the kilns. The hoisting machinery is placed on the top of the hoist framing and consists of rope drums driven through spur reductions by motor. The control gear is of the contactor type operated by push button. Automatic safety gates are provided at the top and bottom of the hoist. The brake levers in the wagon drop are so arranged that effort must be applied to release the brakes, thus ensuring the automatic action of the brakes and the suspension of the cage at any point.

*Blowing Plant.*—As already stated, the two turbo-blowers have been retained, but a third has been put down to act as a stand-by to both furnaces. The blowers are by Fraser & Chalmers, Limited, and each deliver 28,000 cub. ft. per minute at 9½ lbs. pressure.

Steam is raised in a battery of 7 Lancashire boilers 30 ft. × 8 ft. 6 in. at a pressure of 120 lbs., superheated sufficiently to ensure dry steam at the engine stop valves. In addition, there are five Lancashire boilers raising steam at 160 lbs. pressure for a 1,250-kw. Belliss turbo-generator, 3,300 volts, 50 cycles. This is stepped down in a Berry transformer to 550 volts. The 220-volt D.C. lighting circuit is provided for by a rotary converter of 400 kw.

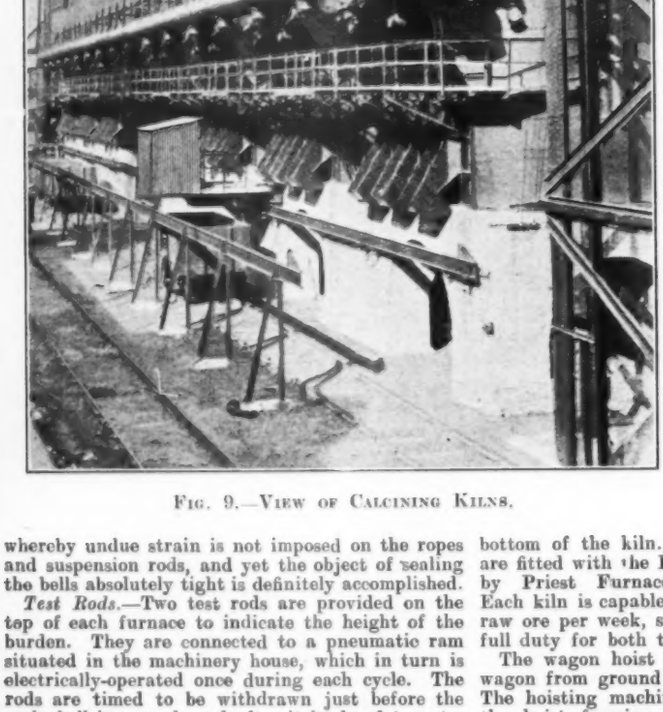


Fig. 9.—View of Calcining Kilns.

Fig. 10.—Front of Ore Bunkers showing Shutes.

## Chelsea Polytechnic's Classes in Metallurgy.

The Department of Chemistry and Metallurgy, which reopens September 24, contains laboratories for wet and dry assaying, metallography, pyrometry, heat-treatment and mechanical testing. Day and evening courses are available, and both are divided into two sections.

The General Courses are suitable for:—(*a*) Students desiring to become industrial and analytical metallurgists, mining and metallurgical engineers; (*b*) candidates for the London University Degree in Metallurgy, the Institute of Chemistry Diploma in Metallurgical Chemistry, and technical students; and (*c*) assayers, analytical and consulting chemists and engineers.

The Engineering Metallurgy Courses are suitable for:—(*a*) Those engaged in the various branches of the metallurgical and engineering industry; and (*b*) candidates for the Institution of Mechanical Engineers' associate membership examination.

Mr. W. A. Naish, A.R.S.M., is the lecturer in metallurgy, and we are sure he will send full particulars to any of our readers on application to him at the Chelsea Polytechnic, Manresa Road, London, S.W.3.

A party of 30 members of the Lancashire Branch of the Institute of British Foundrymen paid a visit recently to Fenton, Stoke-on-Trent, to inspect the blast furnaces and by-product works of the Stafford Coal & Iron Company, Limited.

# Notes on the Routine Analysis of Cast Irons and Iron Foundry Raw Materials—No. 4.

(*Continued from page* 145.)

By Arthur Smith, M.A.

### Estimation of Manganese.

The metallic element manganese occurs in cast iron mainly combined with sulphur and carbon in the form of manganese sulphide and manganese carbide respectively.

Most of the methods used for the estimation of this element in cast irons depend on the solution of the sample in nitric acid, the removal of graphite by filtration, the oxidation of the carbides of iron and manganese to $CO_2$ and the subsequent oxidation of the manganese nitrate to permanganic acid by suitable oxidising agents followed by the quantitative reduction of the permanganic acid by a suitable reducing agent. There are many modifications of the general method, but the author, in his standard method, prefers to carry out the first oxidation by means of ammonium persulphate, followed by oxidation in the cold with sodium bismuthate and subsequent titration with sodium arsenite solution. Sodium arsenite solution keeps well, and, therefore, is much to be preferred to ferrous-sulphate. Likewise it obviates the necessity for any back titration or chromium does not interfere. Also, by using silver nitrate as a catalyst it is possible to do without the second oxidation with sodium bismuthate, and some authorities use this method, but for accurate work the double oxidation is to be preferred. The end point is very sharp, and the method, although simple, is accurate.

*Solutions Required*—(1) *Nitric Acid.*—Prepared by diluted concentrated HNO3 to give Sp. Gr. 1.2; and (2), *Sodium Arsenite.*—A stock solution is prepared by dissolving 60 gms. sodium carbonate (anhydrous) in distilled water, adding 20 gms. arsenious acid and warming the solution until all the arsenious acid has gone into solution. When solution is complete, cool and dilute to 2,000 c.c.s. Exactly 125 c.c.s. of the stock solution diluted to 2 litres gives the working solution, the strength of which should be found by standardising against a cast iron or a steel of known manganese content. Alternatively 2.2 gms. sodium arsenite dissolved in water and diluted to a litre will also give a solution of suitable strength which may be standardised as stated above. Failing a reliable standard steel the solutions may be standardised against a potassium permanganate solution of known strength calculating the strength of the sodium arsenite solution therefrom in terms of metallic manganese.

### Details of Bismuthate-Arsenite Method for Manganese.

The method is extremely accurate for manganese up to 4.0 per cent. If the sample does not contain over 1.5 per cent. manganese it is best to use a 1 gm. sample, while with manganese between that figure and 4.0 per cent., 0.5 gm. sample will be found to be most suitable. Dissolve the sample in a small beaker in 50 c.c.s. 1.2 sp. gr. HNO3, heat until completely dissolved, and simmer for one or two minutes to expel oxides of nitrogen. Filter hot to remove graphite, wash with distilled water, collecting the filtrate in a 500 c.c. conical flask. Dilute if necessary to 250 c.c.s. Add ammonium persulphate crystals 0.5 gms. at a time and boil until carbides are decomposed, as well as excess persulphate, and the solution is nearly colourless. Cool thoroughly as temperature of solution should on no account be over 20 deg. C., and 0.5 gms. sodium bismuthate. Shake for 2 minutes, allow excess bismuthate to settle and filter through asbestos. Titrate the filtrate immediately with standard sodium arsenite and hence obtain percentage of manganese in the sample. Sodium bismuthate may be used throughout, the excess of bismuthate left after the first oxidation being destroyed by means of a reducing agent such as ferro-sulphate; but as sodium bismuthate is an expensive reagent, the use of ammonium persulphate means a considerable saving where many estimations are carried out daily. In the case of white irons, however, it may be found necessary to revert to bismuthate for the first oxidation, and this treatment may have to be repeated several times to get very accurate results on account of the large amount of combined carbon present.

The following points must be observed for the attainment of accurate results, and the allowable error should not exceed 0.2 per cent. manganese:—The sp. gr. of the nitric acid solution must be allowed to exceed 1.135; the solution must be thoroughly cooled before the final oxidation; hydrochloric acid (even the slightest trace) must be absent; any sodium bismuthate passing the filter will count as manganese and so viciate the result; and the titration must be carried out quickly, otherwise the chromium and vanadium may interfere. If the process is properly carried out no elements interfere. Copper, nickel and titanium certainly do not, whereas chromium up to 2 per cent. does not cause any harm, and chromium is unlikely to be present in alloy cast iron above that amount.

### Estimation of Manganese in Ferro-Alloys and Alloy Cast-Irons.

It is seldom necessary to estimate manganese in such alloys as ferro-silicon, ferro-nickel, ferro-chromium, etc., but it is the all important element in ferro-manganese and silico-manganese. These alloys will be dealt with separately. Alloy cast irons usually contain nickel alone, and nickel together with chromium in addition to the usual elements. In all such cases where the chromium content is low the usual bismuthate method has been found to give accurate results.

In cases where the manganese exceeds 4 per cent., other methods such as the basic acetate separation method may have to be resorted to—Julian's chlorate oxidation method for manganese ores and the like may be used, or the following method, usually known as Walter's method, which is especially suitable where a considerable amount of chromium is present. From 0.25 gms. to 2 gms. of the material, according to the approximate percentage of manganese present, is dissolved in dilute sulphuric acid (1 : 4) and oxidised with a few c.c.s. concentrated nitric acid, graphite, if present, being filtered off. Evaporate till fumes of $H_2SO_4$ appear, dilute with distilled water and boil till all the ferric sulphate is in solution. Transfer to a litre graduated flask and dilute to 500 c.c.s. (In the case of high manganese cast iron, direct solution in 1.2 sp. gr. nitric acid will be sufficient.)

Neutralise the greater bulk of the excess acid with sodium carbonate, then add slowly a little at a time an emulsion of manganese free zinc oxide prepared by shaking up zinc oxide with distilled water and shake thoroughly until all the iron (and chromium, if present) is precipitated, the presence of an excess of zinc oxide being indicated by a light brown instead of a dark red brown precipitate. When this is achieved, the mixture is diluted to the graduation mark and the contents very thoroughly mixed. The precipitate is now allowed to settle; part of the clear supernatent liquid is decanted through a dry filter paper and an aliquot portion, say 250 c.c.s., is acidified with the necessary nitric acid to bring the acidity of the solution to the correct strength for oxidation with sodium bismuthate. The estimation is then completed exactly as in the standard method, the quantitative reduction of the permanganate being carried through either by means of standard sodium arsenite or by standard ferrous-sulphate added in excess, the excess being back titrated with potassium permanganate.

In the author's opinion, especially in the presence of chromium, this method of finally oxidising with sodium bismuthate is much more reliable than the direct method of quantitative oxidation with standard potassium permanganate in hot solution which is much more cumbersome.

### Manganese in Ferro-Manganese and Speigeleisen.

Although many chemists recommend a modified bismuthate method for these alloys, with solution in nitric acid together with fusion and subsequent solution in acid of any residue or in case of certain grades of spiegeleisen solution in hydrofluoric acid, followed by repeated evaporation with nitric acid, the ultimate end in view being to get the whole of the manganese in nitric acid solution in a concentration of approximately 0.001 g. per 1 c.c. of nitric acid (sp. gr. 1.135) which is the ideal condition for stability of permanganic acid provided the temperature does not exceed 20 deg. C. This method, however, is expensive in that a large amount of bismuthate is necessary for each estimation, especially so when the material contains much carbon.

Although this method is largely adopted by American foundrymen, the author prefers, for accurate work, to adopt the gravimetric basic-acetate separation, which method is the most reliable, although it is rather tedious. However, it is an exact process and gives very accurate results, and should be used on all check work on cast irons as well as ferro alloys, no matter how small the amount of manganese present. The process depends on the separation of the iron from the manganese as a basic acetate. The method is too well known to elaborate here, but unless all the details of the process are carried out with exactitude, a good separation will not be obtained. At the same time aluminium is also separated as a basic acetate, and the precipitates carry with them any phosphorus and titanium present.

The details of the process specifically applied to ferro-manganese and spiegeleisen are as follows:—Exactly, 0.5 gms. of sample in as finely divided a condition as possible is placed in a beaker with 15 c.c.s. $HNO_3$ (sp. gr. 1.2), to which is added 8 c.c.s. HCl. Heat is applied till the alloy is decomposed, followed by evaporation to dryness and subsequent "baking." Then pick up with 20 c.c.s. Hcl. (concentrated), together with a few c.c.s. of bromine water or other oxidising agent. Heat to boiling and evaporate off all the bromine and most of the remaining HCl. After diluting with distilled water, followed by filtration, if necessary, the iron is precipitated by the usual basic-acetate method by adding first a solution of sodium carbonate, drop by drop, till a slight permanent precipitate is just formed. This slight precipitate is carefully redissolved with hydrochloric acid, and one drop should be sufficient to clear the solution if the additions have been carried through carefully. The bulk of the solution should now be about 350 c.c.s. Add 2 gms. of sodium acetate, heat to boiling and boil for exactly one minute when all the iron should be precipitated. Let the precipitate settle, filter hot and wash precipitate very thoroughly with hot water containing 1 per cent. of sodium acetate. Dissolve the washed precipitate in not more than 10 c.c.s. of hot dilute (1 : 1) hydrochloric acid, and repeat the precipitation exactly as previously. Combine the filtrates from the first and second precipitations, and concentrate to about 250 c.c.s. This solution contains all the manganese, and if qualitative tests have shown the presence of nickel and copper these must be separated from the manganese at this stage. This is easily accomplished by adding a slight excess of acetic acid to the solution and precipitating the nickel and copper as sulphides by passing $H_2S$ till no further precipitate is formed. Any zinc and cobalt, if present, will also be removed as sulphides in acetic acid solution along with the nickel and copper at this stage. The sulphide precipitate is washed with $H_2S$ water and finally the filtrate is concentrated by boiling till all $H_2S$ is expelled. Several methods are now available for the estimation of the manganese which is all contained in this filtrate. The two most common methods are (1) precipitation by bromine as $MnO_2$ and ignition to $Mn_3O_4$, and (2) precipitation by sodium hydrogen, ammonium phosphate (microcosmis salt) and ignition to manganese pyrophosphate $Mn_2P_2O_7$ containing 38 to 68 per cent. of manganese, but more often a combination of the two methods is used namely, precipitation as manganese dioxide, $MnO_2$ followed by solution in hydrochloric acid containing a

little oxalic acid and subsequent double precipitation in faintly acetic acid solution of any iron remaining, followed finally by precipitation with microcosmic salt and ignition to $Mn_2P_2O_7$.

For very accurate work the latter is undoubtedly to be recommended. This method will be described in detail, as it gives the essentials of all three methods.

To the filtrate from the iron, which has been previously concentrated to 250 c.c.s. or the filtrate after removal of $H_2S$, as the case may be, add 8 gms. sodium acetate, together with an excess of bromine water or a few drops of bromine. Heat gently, when the manganese will be precipitated as $MnO_2$, allow to settle, filter and wash thoroughly with hot water. Transfer precipitate to a beaker washing the last traces off the paper with dilute Hcl., containing a little oxalic acid. Heat to boiling, adding small amounts of oxalic acid till solution is complete. Dilute, if necessary, to 200 c.c.s. Make just alkaline with ammonium hydrate, when, if a trace of iron is still present, a slight precipitate will form. Cautiously add acetic acid till solution is just acid, and subsequently heat to boiling, when any iron present will separate as ferric-hydroxide. Filter, wash with hot water, etc., redissolve in a few c.c.s. of dilute HCl., dilute and precipitate exactly as previously. If a trace of iron has been found at this stage, this double precipitation is essential. Combine the filtrates, heat to boiling, and add an excess of a saturated solution of microcosmic salt, with constant stirring. Add a slight excess of ammonia drop by drop with continued stirring. Boil till the originally flocculent precipitate becomes crystalline and settles quickly. Allow to cool and filter off the pink manganese phosphate. Wash with cold water containing 1 per cent ammonium hydrate, and finally ignite and weigh as $Mn_2P_2O_7$.

The basic acetate method is one which is often a bug-bear to junior assistants, but if attention is paid to the important points it need not be so, and carefully executed it gives very accurate and reliable results.

**Points to be Noted.**

The following details especially require to be carefully followed:—(*a*) See that the original solution containing the iron is completely oxidised before proceeding, as the presence of any ferrous salts will result in the familiar brick red unfilterable type of precipitate; (*b*) ammonium salts should be absent when the manganese dioxide is precipitated, else incomplete precipitation may result, and (*c*) the quantities and similar details must be rigidly adhered to.

A quicker and sufficiently accurate method for most routine work is that which is usually known as Julian's method. Although perhaps not quite so accurate as the basic acetate method is in the hands of a skilled analyst, for routine work by junior chemists it will often be found to be more suitable. The ferro-manganese sample is dissolved in nitric acid, and the manganese completely oxidised by the addition of potassium chlorate. A known volume of a standard solution of hydrogen peroxide is then added to the cooled and diluted solution, the excess peroxide being titrated against a standard solution of potassium permanganate.

*Preparation of Necessary Solutions.* — (*a*) Standard potassium permanganate solution is made by dissolving 1.7375 gms. pure potassium permanganate in distilled water and diluting to 1,000 c.c.s.; and (*b*) standard hydrogen peroxide solution is prepared as follows:—Dilute ½ lb. of hydrogen peroxide with 300 c.c.s. of distilled water (cold), add 100 c.c.s. of sulphuric acid slowly and dilute solution to 5,000 c.c.s. with distilled water.

The hydrogen peroxide solution is best standardised by adding a definite amount of a pure manganese salt to a steel, the manganese content of which is already accurately known, and treating this composite sample exactly as in the method to be given for ferro-manganese.

The equivalent strength of the potassium permanganate solution in terms of the hydrogen peroxide solution is obtained as follows:—60 c.c.s. of concentrated nitric acid is boiled for a few minutes. After cooling, it is diluted to about 300 c.c.s. with cold distilled water. Then 50 c.c.s. of the hydrogen peroxide solution is then added to this cold solution of nitric acid, which is then titrated with the standard potassium permanganate solution, a relative value being thus obtained for the latter.

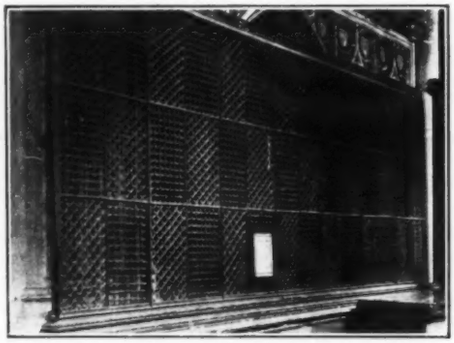
*Details of the Method.*—Weigh 0.25 gms. or 0.5 gms. of the ferro-manganese sample, transfer to a beaker, and add 40 to 60 c.c. of nitric acid (sp. gr. 1.2), boil till all the sample is in solution and then evaporate almost to dryness. (If preferred a larger sample may be dissolved in nitric acid, the solution cooled, made up to a definite volume and aliquot portions evaporated almost to dryness). Add 50 c.c.s. of concentrated nitric acid, heat to boiling, and while boiling add pure solid potassium chlorate, a crystal at a time until green chlorine fumes cease to come off and are replaced by white fumes. Boiling for a few minutes longer, cool, dilute to about 250 c.c.s., add 50 c.c.s of standard hydrogen peroxide solution. This converts the insoluble manganese dioxide into soluble manganese nitrate. When solution is complete titrate the excess hydrogen peroxide with standard potassium permanganate, thus finding the amount of hydrogen peroxide which reacted with the manganese dioxide, and hence the percentage of manganese present in the sample.

## A Magnificent Grille.

By H. Littlehales.

One often hears the statement made that on the Continent the most wonderful metal-work is to be met with, but it is not so readily realised that no finer craftsmanship is in existence than is to be found within a 'bus ride of London. For instance, two of the finest grilles ever constructed by the metal-worker are to be found, the one in Westminster Abbey, the other in St. Alban's Cathedral.

That at Westminster (the great grille surrounding the tomb of Henry VII) is well known, but the other grille, far less elaborate but exhibiting beautiful design and most interesting craftsmanship, has hardly received the attention the work demands. This grille was made about 500 years



The Grille in St. Alban's Cathedral, consisting of 42 Panels.

ago, a hundred years earlier than the grille at Westminster. That at Westminster is of brass, with much ornament, towers, figures, etc. That at St. Alban's is far less ornate, but of a very exquisite simplicity and yet, in its way, of an elaborate intricacy. It consists mainly of no less than 42 oblong panels of interlaced iron bars, of alternately crossed bars and reticulated work. Each panel is one or two feet across, the whole grille being some 10 ft. in height, with not a cresting, but a horizontal line of ornament at the top. This top is of small, square, pierced panels. The base is moulded. This grille is said to have been used to restrain the too ardent and enthusiastic pilgrims to the shrine of St. Alban.

The picture is supplied by the courtesy of the Director of the Victoria and Albert Museum.

Messrs. John I. Thornycroft & Company, Limited, of Woolston Works, Southampton, have received an order from the Crown Agents for the Colonies for a twin-screw passenger steamer for service on Lake Albert, Uganda. The vessel will be constructed to their own design. Messrs. Rendel, Palmer & Tritton, London, will supervise her construction.

## Charging Blast Furnaces.

**Belgian Practice.**

By Georges Descamps.

The controversy as to bucket- *v.* skip-charging has been virtually settled in Belgium in favour of the bucket system, charging with which, it is claimed, ensures a controlled and uniform handling of ore, coke, limestone, etc., on which the regularity and smooth working of the furnace depend. The collection, transport, hoisting and distribution of the materials forming the burden have now to a great extent been standardised throughout the country, and a brief description of the details of a typical plant of the kind most favoured among Belgian ironmasters may be of interest.

The system here described is that adopted by the Soc. Anon. Ateliers de Construction, de Chaudronnerie et d'Estampage, d'Awans, Belgium, and is installed at a large number of Belgian ironworks. The Company manufactures and supplies complete equipments for the production of pig-iron, including the Cowper stoves, the blast furnaces themselves with all accessories, gas purifiers, and all appliances for handling and loading the pig-iron to the stock yard and from here to the wagons, and also for the removal and disposal of the slag.

The coke is taken direct from the wagons by buckets of the Staehler type with bottom flaps and gas-tight covers, thus diminishing the amount of handling losses due to breakage and dust, which are inevitable when any method is employed in which the coke is emptied into hoppers and taken from these by grabs and belt conveyors.

The loaded buckets are placed by the coke stock-yard overhead cranes, on bucket trucks, which automatically take them to the foot of the hoist which may be inclined or vertical. From here they travel up to the charging platform, the trucks receiving the empty buckets and returning them to the coke yard. One crane driver is able to attend to the entire handling of the coke at ground level, even when a group of two, three or four furnaces has to be supplied.

The same system is employed for handling the coke required for roasting the iron ore and for delivering the ore to the kilns from the wagons in which it arrives, or the storage bins. The ore, limestone, etc., are handled in the same way.

The ore bins are so arranged that the different qualities of ore are stored separately and the quantities taken from each bin are accurately weighed. The trap doors at the bottoms of the bins work automatically and are of easy control. The buckets rest on a mushroom seat with rotary movement. By a special arrangement their weight is automatically registered, the readings on the beam being in full view of the operator who can control each operation.

This system of loading by Staehler buckets, and vertical hosting permits of strict control of the blast-furnace burden. The bucket placed on the transfer truck passing under the various bins containing different grades of ore, takes the determined quantity from each kind of iron ore, manganese ore, scrap, etc., thus obtaining the exact mixtures for the blast-furnace burden.

Arrived at the bottom of the hoist, the loaded buckets are raised to the furnace top where the bottoms of the buckets drop open and their contents are charged into the furnace, the tops being closed during this operation by airtight covers which in due course are released when the bucket is lifted. This manœuvre prevents the gas escaping from the furnace during charging, and allows the bucket to evacuate any gas contained therein; thus there is no risk of an explosion or any danger to the men.

Including the men in charge of the cranes, at the pig-iron sheds, coke sheds, and at the loading winch of the hoist on the furnace top, five men are sufficient to carry out all the work entailed by keeping four furnaces going.

Two hot-blast stoves are usually employed for each blast furnace. For cleaning the gas the Theisen washer is very generally employed.

# Notes on Patternshop Management.—IV.

By Ben Shaw.

## EQUIPMENT.

Patternshop production depends very largely on proper machinery equipment, yet it is not often that, even in a large patternshop where there is much heavy circular cutting, there is a left-handed as well as a right-handed band-saw. The value of the different hands is that cutting curves is often facilitated without the work having to be reversed. The jig-saw has never been popular in patternshops, and it can be ruled out as a production factor. Unfortunately, few, even of the largest patternshops, have the machine equipment that have plenty of machines, but they are obsolete types, and it does not seem to have occurred to firms that it would be good business to get rid of them and replace them with modern machines. The circular-saw bench of to-day, for instance, is a much more efficient machine than those that were made thirty years ago.

Jobbing shops are often handicapped in the matter of machinery, and it is really surprising how many of these concerns obviously do well with only a lathe or a jig-saw and a lathe. No enterprising firm can, of course, be without machinery, and, apart from the lathe and some kind of saw, preferably a band-saw, the most important machine is the sandpapering disc. It is always possible to rig up a sandpapering disc, although a proper machine is certainly best, and the amount of hand labour which such a machine saves is amazing. Reduced labour costs will soon amount to more than the cost of the machine. Some machines are, of course, more important than others. For instance, a planing machine is very convenient, but timber can be obtained planed at small extra cost; but it is not possible to give out sandpapering or band-sawing, nor is it advisable to give out turning even when it is possible. The operations on these machines must be done as the work proceeds, and the use of any one of them at a certain stage in the construction may save many hours' work.

### Bench Equipment.

Patternshop equipment includes more than machinery, of course. Bench tools are part of the equipment, but, although one or two firms in this country supply bench tools, they are in nearly all shops the men's own property. Drawing-boards are indispensable equipment. In every patternshop a supply of drawing-boards should be stocked, in sizes suitable for the class of work done. It is extremely wasteful to allow boards to be left about the shop and sawn up for odd purposes. Sometimes very large work can be laid out on the floor of the shop, and the work built on top of the drawing. This is especially the case with patterns for large steel castings as used in ship-construction work. For engine work of all kinds, and for machine work, drawing-boards ought to be used, as they can be sent to the foundry and are invaluable to the moulder when setting his cores, because he can then measure metal thicknesses. Most moulders experience difficulty in reading blue prints, and it is not advisable they should use such drawings, excepting for the location of cores, because machining and other allowances are not shown on them.

A patternshop may be excellently equipped with the most modern machinery and yet be less efficient than a shop with fewer and older machines. A great deal depends on the condition of the machines. In a large shop it is always profitable to employ a whole-time machinist, and while there may be a difference of opinion as to whether a woodworking machinist or a patternmaker fills the position best, what is indisputably true is that the patternmaker is the most efficient machine user. The patternshop differs from other woodworking shops, such as joiner's and cabinetmaker's, because the patternmaker has invariably just one or two pieces to make to a certain shape, and they have to be accurate measurements, whereas the joiner and the cabinetmaker work primarily for appearance, and, as a rule, in large quantities. The patternmaker has also more awkward shapes to deal with. It is practicable for a joiner or cabinetmaker to take work to a band-saw, give instructions to a sawyer, and leave it to be sawn. The patternmaker, on the other hand, has to enter into a considerable explanation, and in all probability has to stand by while the cutting is being done. Thus, whether a patternmaker or machinist is employed for sharpening, the patternmakers ought in most cases to do their own cutting. The importance of this part of patternshop management is great, as the production costs are considerably reduced if the machines are in good order and the greatest use is made of them. With regard to this, the foreman has to keep a sharp lookout, as some men would sooner toil for several hours at the bench than do the work in a few minutes at a machine. The best type of workman appreciates machinery, and will devise all sorts of ingenious jigs to minimise labour. A tactful foreman can often give a lead here, so much so that in some shops jigs for the saws and other machines are very much in evidence.

The band-saw has been termed the patternmaker's universal machine. It is recognised that, with the exception of the wood-turning lathe, no machine is more valuable. It is almost indispensable in the turning out of work economically and in increasing working efficiency. A patternshop without a band-saw is unworthy of the name. It must be recognised, however, that without judicious care, initiative, and skill on the part of the operator it may not give the return it would otherwise give in the hands of a capable and experienced man.

### Band-Saw Operation.

In the hands of a good machinist the band-saw becomes the most efficient tool in the shop, breakages are reduced, renewals less frequent, and work accomplished in such a manner as to leave the least possible amount of work to be done by hand. Such a man makes the machine a paying investment.

The band-saw is usually the most troublesome machine in the shop. Many patternmakers do not realise that there is a safe limit in the cutting of small circles and curves, beyond which it is unwise to go. How many appreciate the fact that there are saws and saws, and that outside appearances may not, and often do not, count one little bit toward performance? How many know that a fine steel wire stretched from wheel edge to wheel edge will often reveal sufficient but unsuspected misalignment to account for trouble?

In every instance the frame of the machine carrying the arm is on the left-hand side of the worker; of course, it does not matter much when only one machine is installed, but when there are two or more, then one, at least, should be made with the frame on the right of the worker, so that large work can be accomplished without leaving a considerable amount to be done by hand. For ordinary work it makes no difference what hand the saw may be, excepting perhaps when bevelling work, and that is not affected if the table can be bevelled both ways. So that a band-saw installed, being handed opposite to those usually installed, would do similar general work, but would be an advantage in cutting large work.

There are some patternshops in which there is a circular saw but no band-saw. It is not often that one finds an improvised wooden saw bench nowadays, and apart from the risks involved these are not very satisfactory, because their scope is so limited. In a patternshop where there are both band and circular saws each has its own definite uses; there should be no straight cutting of timber on the band-saw or shaping of segments on the circular saw, but when only one saw, either band or circular, is installed, then all sorts of operations have to be performed by it, and its limitations are determined to a great extent by the initiative and ingenuity of those using it. Many simple jigs can be devised for patternshop machines, saws, planers, and trimmers, which greatly increase their usefulness.

### Three Types of Circular Saws.

In large patternshops there should be three circular saws, a large one for ripping, a small double-purposes machine with rip and cross-cut saws, and a pendulum or swinging saw for the timber shed. The last type of saw is not common, which is rather surprising, because it is such a time saver. The band-sawing of rough timber is slow work and hard work, and especially so if the timber is not perfectly dry. Most firms would get a surprise if they could obtain accurate figures of the time wasted in the timber shed breaking out timber for new patterns, and it is time that cannot be much reduced with the best of management unless the handling and sawing of timber is reduced to a minimum. With a swinging saw in good condition all the timber for a large job can be cut up in a very short time. As it is a dangerous machine apprentices should not be allowed to use a swinging saw.

Inside the shop there ought to be a saw bench for heavy work, and, indeed, that is suitable for all plain work. If the saws are properly maintained much bench work can be obviated on such a machine. The fence should be capable of accurate adjustment because then the machine can be used for cutting half laps and doing similar work. With the exercise of a little ingenuity in the construction of simple jigs, angle cuts can be accurately and safely made on an ordinary fixed-table saw bench, but a saw cannot long be maintained in good condition if it is used for making circular cuts, such as segmental work.

### Other Types of Saws.

Next to the band-saw perhaps the most useful patternshop machine is the saw bench on which two saws are mounted on parallel arbors and are so arranged that either of them can be brought above the table, and also so that the depth of cut or amount of saw exposed can be controlled. Such a saw bench is a multiple-purpose machine in the widest sense. One fence is so arranged that it can be tilted to various angles. The table is in two parts, the one half furthest from the fence moving backwards and forwards on rollers when desired, while it can be locked in place. The entire table can be tilted to any angle up to 45 degrees, which is very useful when sawing out staves for cylinders and similar work. There are several useful attachments for this type of saw bench—often called a "dimension" saw—and it will cut nearly all angular forms. The fence for cross cutting is of exceptional value, and if both rip and cross-cut saws are properly sharpened it is often possible to joint timber taken from the machine without touching it with bench tools.

Not many patternshops are without a planing machine of some kind. The bench planer for short lengths has not proved popular for some unaccountable reason, although it is undoubtedly a labour saver. A large proportion of a patternmaker's time is spent planing short lengths of timber with hand planes that could be done more quickly on a machine. It may be that when trade returns to normal again firms will realise the value of small bench planers.

### Planing Machines.

Planing machines are divided broadly into (1) surfacing machines, (2) thicknessing machines. It cannot be said that one is more useful than the other. The value of a surfacing machine depends, to a considerable extent, on the skill of the operator, and especially is this so when taking a piece of timber out of twist. On the ordinary type of surfacing machine the work is fed over the table by hand, and straightening the timber depends largely on how it is fed. The top table surfacing machine is valuable for chamfering levelling surfaces, and, by using special knives, for planing out concave surfaces. In the thicknessing machine sometimes cutting is done on the top table, and also between the tables.

### Trimming Machines.

No patternshop is well equipped that has not trimmers, and the more of these little machines the better. The trimmer is a machine for producing good end grain surfaces, and was probably first placed on the market because of the difficulty of producing good surfaces with hand tools. Patternmaking costs can be considerably reduced when there are large trimmers and small bench trimmers. The usefulness of a trimming machine depends entirely on it being in first-class condition. The patternshop manager or foreman should insist on trimmers being carefully treated, because if it is necessary to finish surfaces subsequently with hand tools they simply constitute an unnecessary expense. The trimming-machine knives must be sharp to do good work. The most important use of a trimmer is when building segments. Some craftsmen trim all the edges of the segments at the machine, and afterwards plane them on a shooting board. If a trimming machine is in good condition, it makes a perfect finish, and it should never be necessary to plane edges after being trimmed.

### Sand-Papering Machines.

The double-disc sand-papering machine is installed in many patternshops, and with the machine are many useful attachments. This machine obviates the paring of external curves with chisels, and for internal curves rotary sanders are used. There are many other types of sanders in use for woodworking, but the common disc and rotary machines are most useful in patternshops. In the disc type of machine the discs are of metal, and very accurately balanced, and the bearings which carry the spindle being long, a high velocity is obtainable, and, in consequence, the work turned out is of excellent quality. The sand-paper is quickly stretched across the face of the disc, and held in position by a steel ring, which is made fast by thumbscrews. These also serve to regulate the amount of strain to which the surface of the paper is subjected. The work to be sand-papered, or "trimmed," is placed on the table in front of the disc. The rotary vertical spindle machine is for sand-papering the internal and external edges of curved and irregular pieces of woodwork by means of a vertical sand cylinder. The vertical sand cylinder is 2 ins., 3 ins. or 4 ins. in diameter. The spindle may run at 2,400 r.p.m., and has an oscillating motion imparted to it by means of an eccentric, to prevent the wood from being marked by the sand-paper. The sand-paper is quickly and securely fixed by pins on the split wooden cylinder, and is easily removable. Careful supervision of the sand-papering machines is essential if they are to be labour saving.

### Obsolete Lathes in Use.

It is rather surprising that even to-day many patternshop lathes are only fit for the scrap-metal merchants. Metal-turning lathes can often be reconditioned, and prove very satisfactory for pattern turning, but some works' managers appear to think that accuracy is not essential in wood turning, and they overlook the fact that with an unsuitable lathe it may take twice as long to turn a job. Many patternshops dispense with a large face lathe, but it is a very useful machine. The face lathe is specially designed for use in patternmakers' shops where it is required to turn work of a large diameter, such as patterns for engine flywheels, pulleys, etc.; it can also be employed to advantage in the manufacture of wooden pulleys, but this is not patternshop work.

One of the most useful types of lathes is that which is called a double lathe, and which has a capacity for dealing both with very large and very small articles. This is precisely what is required in a patternmaker's shop, where small patterns of a few inches in length are continually being turned, and the patterns of very large cylinders, drums and flywheels have also to be dealt with as occasion requires, and if there is not sufficient work for several lathes. On the top of the bed are the fast and loose headstocks for two independent lathes of different capacities. As both headstocks are driven from separate countershafts, the large and small lathes can be worked independently of each other, whereas when it is a question of dealing with very long material, the small headstock and its back centre can be bodily removed, and the back centre of the large lathe shifted to the extreme end of the bed.

### Wood-Millers.

One of the most important machines in a moderately large patternshop is the wood miller. This machine will do much work that would ordinarily be done on the lathe or by the saws, but much more quickly. It also takes the place of the old corebox machine, which was never very popular. The operator of this machine should be a patternmaker, and the more highly-skilled he is the more valuable is the machine.

### Grinding Machines.

It is seldom that sufficient attention is given to grinding machines, and yet on suitable facilities for grinding edge tools the efficiency of a shop largely depends. Grindstones are simply natural sandstones of such texture that they are suitable for grinding operations. The cutting material is oxide of silicon or quartz sand, held in a calcareous or lime cement, or in a silicate bond which is of such a nature and strength that the dull grains of sand are torn from the stone by friction and fresh sharp grains uncovered for the work of grinding. It is not very often that natural stones are used now. Artificial grindstones have been made that have the advantage of being more uniform in texture than natural stones. They have largely taken the place of sandstones for grinding. It is usually profitable to instal a special grinder for planing-machine irons, in which the irons are bolted to a holder mounted on a compound slide rest, the holder being arranged to cant at different angles for varying the bevel of cutters, and brought to an emery cup by means of a fine pitch screw and hand wheel. Another necessary grinder is for gouges. This machine is fitted with several grinding wheels of different thicknesses, and the grinding wheels can be turned up to fit the rounds and hollows of gouges.

*(To be continued.)*

## Iron in Antiquity.

Our contemporary, "Antiquity," for June contains an interesting note by Professor Sayce, the world-famous author, on the earliest records of iron-working. Mr. Wooley has found in a cemetery of Ur of the Chaldees an iron instrument which he dates B.C. 3500. Kara Eyuk, in Cappadocia, was the centre of the Assyro-Babylonian trade in B.C. 2300, the metal mines of the Taurus being then actively worked by Babylonian firms, whose agents and representatives were mostly Assyrians. Caravans and posts passed along the roads, and intercourse was kept up with Syria, Assur and Babylon. The following is a reproduction of the text of a document of the period:—

"To Uzua, Maza, Sume-abia, Asir-malik, Amir-Asir, Su-Anum, Asir-imeti and Amur-Istar writes as follows El meti: 4½ shekels of iron of best quality, complete, with my seal, Amur-Asur, Su-Anum Asur-imeti and Amur-Istar have taken to you. My brother has said: give us this iron at its value, half a maneh of silver with the seal of Iti-abem, which Amur-Asur on behalf of Nitsini has taken, and for us with the price of the iron, viz., half a maneh of silver, seal it and to Amur-Asur give it, and on behalf of Nisini let him bring it."

The word used for iron can have the meaning "metal of heaven," and is taken by Professor Sayce to indicate that the first iron worked was of meteoric origin It appears that the Egyptians derived their words for both silver and iron, and, therefore, in all probability the metals themselves, from Asia Minor.

The word for iron, barzel in Hebrew, parzel in Chaldee, parzillu in Assyrian, and ba-n-pet in Egyptian, is said to clear up the name and character of the mysterious "Perizzites" of the Old Testament. They were the metal-workers, more especially the workers in iron, among the inhabitants of pre-Israelitish Canaan.

## Weather and Supplies.

(From a Correspondent.)

At a time of the year when the weather forecast is studied by the general public with an almost absorbing interest, it is worth while pondering on the effect which sunshine and storm may have upon the commercial community, and particularly upon supplies of raw material. Climatic conditions are, of course, responsible for the segregation of various industries in different areas of the world's surface, and in a narrower sense we find in our own country the establishment of trades in districts pre-eminently suited for them. The damp atmosphere in Lancashire, coupled with proximity to a great Western port, has settled the home of the cotton industry, while the Burton water has proved of exceptional value to the brewer.

These are physical characteristics of particular districts which remain more or less constant, but all trades are at the mercy of exceptional weather conditions, either locally or in some far-distant spot from which they draw their raw material or some adjunct to manufacture not obtainable elsewhere. The effect of weather upon crops is, of course, known to everyone, but to the average person "crops" means wheat and very little else, whereas in reality an enormous number of foodstuffs and commodities should come under that heading. Prolonged storms at sea put up the price of fish, while an exceptional spell of fine weather on land shrivels the pasturage and may increase the cost of milk.

Perhaps the outstanding example of the connection between weather and commercial and national prosperity is furnished by the Indian peninsula, where the breaking of the monsoon is the signal for a revival of trade and the extent of the rains an almost certain indication of what conditions will be during the ensuing months. If the monsoon be unfavourable India's purchasing power is lessened, and the demand in this country for the metals, machinery, etc., which we export to her is reduced. This is, of course, an illustration of the broad effects of regular physical phenomena, a similar example being the annual flooding of the Nile in Lower Egypt. Any failure on the part of the "weather" to come up to expectations can be almost as disastrous in such cases as a violent convulsion of nature, such as an earthquake or volcanic eruption. Recently it will be remembered that prolonged and torrential rains caused terrible floods in the Southern States of America, and delayed shipments of raw materials from the Gulf ports.

Turning from these great events to matters of smaller moment, it is interesting to notice that the spell of real "seaside" weather during July, which delighted all holiday makers and made brisk trade for a hundred and one interests dependent upon sunshine and clear skies, caused grave anxiety to canal carriers in Germany, where a prolonged drought caused the water level to fall to such an extent that transport of goods suffered. This, in its turn, was reflected on the London Metal Exchange, where the price of early spelter was marked up through lack of declarations. A far cry from Germany to Whittington Avenue, but the barges with their loads of zinc were grounding on the mud for want of rain! Waterborne traffic was delayed in this country before Christmas through the canals freezing over, and some of the works in the Midlands found their raw material and fuel delayed for a few days.

Since the alteration in the methods of marketing copper, and particularly during last winter when manufacturers were carrying only small stocks and merchants had practically nothing to offer, delays in shipping proved a great handicap to consumers. Heavy weather at sea frequently delays the great ocean liners for a couple of days, and some of the smaller boats bound for Bristol are held back even longer. On the longer voyages from Vancouver and Tasmania with spelter, and with copper and nitrates from Chile, a similar risk occurs, and it is decidedly unwise therefore to figure out a work's programme without some consideration for the vagaries of the weather.

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# The Machine Tool and Engineering Exhibition.

The fourth exhibition promoted by the Machine Tool Makers' Association, was opened last Wednesday at Olympia, London, by Mr. W. C. Bridgeman, First Lord of the Admiralty. The exhibition, which will remain open until the 22nd inst., is semi-international in character (as a ban on German manufactures still exists) and now constitutes a unique feature in British industrial life. Unquestionably, the present exhibition has brought together the finest assembly of machine tools that has ever been exhibited in this country, and will make an appeal to the engineering departments of both the foundry and metallurgical industries.

## MACHINE TOOLS.

On the occasion of the last exhibition we devoted a considerable amount of space to a description of post-war developments in machine tools. We find that progress on the lines we then indicated has been maintained. Individual motors commanding the various motions built in with the machines is a tendency generally to be noted. Of lathes, drills, planers, slotters, grinders and similar tools there exist numerous examples on the stands of Alfred Herbert, Limited, of Coventry; Wm. Asquith (1920), Limited, Halifax; Buck & Hickman, Limited, London; Burton Griffiths, Limited, London; Chas. Churchill & Company, Limited, London; Churchill Machine Tool, Limited, Manchester; J. Lang & Sons, Limited, of Johnstone, near Glasgow; Smith & Coventry, Limited, of Manchester; and H. W. Ward & Company, Limited, of Birmingham. There is abundant evidence that the machine-tool makers have so designed their manufactures that they can provide each section of industry with machines not merely specially suited to its requirements, but made largely automatic.

## WOOD-WORKING MACHINERY.

**Wadkin & Company**, Leicester.—For concerns having pattern or wood-working shops connected with their plant, this exhibit is of considerable interest. Most of the tools are direct motor-driven, often with separate motors for each movement. Two wood millers; an 18-in. canting-spindle dimension saw; a 30-in. band-saw; a 20-in. × 9-in. combined surfacer and thicknessing machine; an overhead recessing machine; a combined disc and vertical bobbin sunder; and 18-in. saw-bench with rise and fall table, comprise a representative collection of modern wood-working machine tools. All the machines have been studied from the angle of meeting the latest Home Office Regulations both as regards guarding and dust removal.

**Thomas White & Sons, Limited**, Paisley.—The exhibit of this company is divided into, roughly, two parts, the one on the ground floor being a collection of wood-working machinery, and that in the gallery being devoted to abrasive papers. Of the former, ten types of machines are showing, amongst which are to be noted an under-feed radial-arm saw-bench; a beltless spindle moulder; a multiple spindle dovetailer; a 42-in. triple-drum sanding machine; and a 9-in. × 3-in. planing and moulding machine.

**Thomas Robinson & Son, Limited**, Rochdale.—An extremely wide range of wood-working machines is being shown by this company, the most noteworthy amongst which is a vertical band re-sawing machine, which can re-saw battens and large flitches at the rate of 250 ft. per min. Other interesting exhibits include a straight-line edging and ripping saw bench; a three-drum sand-papering machine; a tenoning machine for working single and double tenons; top and bottom scribing, cross cutting and trenching, and a vertical hollow chisel mortising and boring machine.

## ABRASIVE WHEELS.

**Universal Grinding Wheel Company, Limited**, Stafford.—Precision grinding is becoming more extensively used every year, and this exhibit is designed to the extensive range of wheels available for meeting this demand. The Bauxilite wheels are for dealing with steel, and Unirundum for cast iron and brass.

**The Carborundum Company, Limited**, Manchester.—As time goes on, the development of carborundum becomes more and more widespread. At one time restricted to wheels, of which a very large assortment is now available, its use has now extended to valve grinding compounds, abrasive cloth and paper, and grains and powders for buffing and polishing. Still more recently it has developed as a high-grade refractory, so much so that a second stand has been taken to exhibit a range of crucibles, bricks and slabs. The crucibles have been shown to be useful for the brasses and bronzes, and for aluminium, after "tempering" by a few melts of brass or the like, but not for steel on account of alloying.

**B. R. Rowland & Company, Limited**, Reddish.—This firm is showing a very complete range of grinding wheels made by the vitrified, silicate and elastic processes, using silicon carbide as the abrasive for grinding brass and cast iron, and corundum for dealing with steel and wrought iron. Non-slip tiles is a speciality now to be associated with this industry, whilst the refractory end of the business is illustrated by examples of muffles, bricks and special shapes ready for incorporation in furnace structures.

## ELECTRIC CONTROLLERS.

**Watford Electric & Manufacturing Company, Limited**, Watford.—Push-button control is now used for operating plant as widely separated as a blast furnace and a common drilling machine, and this firm has specialised for many years on this particular type of control. Nine types of machines have been placed on the stand to demonstrate its various applications, mainly to machine tools.

## COMPRESSORS.

**Broom & Wade, Limited**, High Wycombe.—Three types of air compressors, a speciality which one always associates with this firm, are being shown. The first is a portable petrol-engine-driven plant delivering 100 cub. ft. of free air per minute; the second is a 2-cylinder of 10-in. dia. and a 12-in. stroke machine delivering 300 cub. ft. of air per min., whilst the third is similar to the second but smaller, having a capacity of 130 cub. ft. per min.

**Reavell & Company, Limited**, Ipswich.—An important range of compressors is being shown on this stand. The principal exhibit is a vertical two-stage double-acting compressor designed for pressures up to 120 lbs. per sq. in. In addition to two quadruplex machines, there is a 5-size range of vertical single-acting and two-cylinder compressors, varying in capacity from 4 to 170 cub. ft. per min, suitable for pressures up to 100 lbs. per sq. in. For pressures up to 1,000 lbs. per sq. in. there is a compressor of the two-cylinder single-acting type.

## GRINDING MACHINES.

**Snow & Company, Limited**, Sheffield.—This firm is showing three types of surface grinders. Two are of the vertical spindle type, and the third a horizontal machine. The "V.R." type has a 32-in. dia. work table and 20-in. dia. grinding disc, whilst the "V.A." has a 42-in. by 13-in. table and a 14-in. dia. grinding disc. The horizontal-spindle machine has a 42-in. by 13-in. work table. Naturally other sizes are available, and the dimensions given are of the actual exhibits.

## WELDING EXHIBITS.

**G. D. Peters & Company, Limited**, Slough.—This firm is showing the Wilson plastic-arc electric-welding plant. Three types are being demonstrated. The largest requires two operators and is rated at 300 ampères. It is fitted with a current-control panel designed to maintain the welding current constant within 5 per cent. The second set is portable, is petrol-driven, and has a capacity of from 75 to 200 amps. The third machine is a light-weight portable single-arc motor-generator set. In the gallery, this firm is demonstrating Graphol—a material for releasing rusty nuts from bolts.

**Allan Liversedge, Limited**, London.—At one time one invariably associated the activities of this firm with acetylene, but in recent years their scope has been considerably extended, and on their stand they are showing an arc-welding set, seam welder, spot welder, rivet heaters, stelliting apparatus and material, oxy-acetylene and air-acetylene equipment, surface-hardening outfits, and soldering and brazing tools.

**British Secheron Company, Limited**, Westminster.—Alternating-current welding machines, including a portable set designed for connecting direct to alternating-current machines are being shown on this stand. Five sizes are available. For the electrodes used with this machine it is claimed that they are exothermic, and fulfil both electric and metallurgical requirements.

## TRANSMISSION OF POWER.

**P.I.V. Chain Gears, Limited**, London.—The P.I.V. system is one of the latest developments in power transmission, and the ability to change speed without changing gears is one of the most interesting of modern inventions. The system has been fully described and illustrated in our columns, and a visit to the stand demonstrates how its applicability has been and is being extended. At the moment 10 h.p. is the maximum load being dealt with. Three sizes are available, 3, 5, and 10 h.p., and in each case a 4.1 speed variation is given.

**Ransome & Marles Bearing Company, Limited**, Newark-on-Trent.—The demand for bearings has become so extensive that this firm now markets no less than 3,000 sizes of various types, a comprehensive selection from which is being shown, including the ordinary single-row ball journal bearings, double-row self-aligning and also the rigid type ball journal bearings; bearings for magnetos; double purpose, roller journal, roller bush; single and double thrust, and line-shaft bearings of various types.

**Hans Renold, Limited**, Manchester.—The chain drives made by the company are too well known to need detailed description. It will be remembered that two types are made—the bush roller and the inverted tooth. Both are being shown on the stand. To illustrate typical uses a line shaft drive has been arranged running drilling and mortising machines. A second application shown is for conveying and elevating.

**Hoffmann Manufacturing Company, Limited**, Chelmsford.—This well-known house has divided its exhibit into two sections, the one showing a range of their products and the other their application in industry. In the second category they have included the driving of an electric motor; a pair of fans; a multi-drilling machine; a worm-reduction gear and a broaching machine.

## TOOL STEEL.

**Hall & Pickles, Limited**, Manchester.—The main object of this stand is to provide demonstrations of the cutting ability of their various brands of high-speed steel. For their other steels they exhibit a number of typical fractures and the machinability of J. & L. steels. Fractures of Thorncliffe pig-iron are also exhibited.

**Samuel Osborn & Company, Limited**, Sheffield.—In order to demonstrate their various brands of tool steel, particularly their latest development, S.O.B.V. cutting alloy, they have installed a powerful lathe, by John Lang & Sons, Limited, of Johnstone, whilst a box body vertical drilling machine by William Asquith, of Halifax, is employed for illustrating the penetrating power of their high-speed steel twist drills.

## INDUSTRIAL FURNACES.

**Wild-Barfield Electric Furnaces, Limited**, London.—This firm, which, by the way, was known as Automatic & Electric Furnaces, Limited, until a few days ago, is showing a comprehensive range of electro-magnetic hardening equipments in active operation, imitating works conditions by collaboration with chuck and tap makers. A new model with a chamber 16 in. dia. by 28 in. long for gear hardening, is shown for the first time, as are also two high-speed hardening furnaces in which the ageing difficulty to be associated with carborundum heating elements has been overcome

(*Continued on page* 196.)

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## Trade Talk.

Messrs. Richard Thomas & Company, Limited, have restarted a blast furnace at their Redbourn Works, Scunthorpe.

A large order for rails and sleepers has been placed with the Steel Works Union by the German State Railway Company.

Loudon Bros., Limited, Glasgow, have secured a repeat order for wheel and axle plant for the New Zealand Government Railways.

Due to further labour troubles at the port of Le Havre, the Union of Labour Employers has declared a lock-out as from September 1.

The registered office of the Mansfield Engineering Company, Limited, is now at their Hucknall Works, Watnall Road, Hucknall, Notts.

The address of the National Union of Blastfurnacemen, Coke Workers, Oreminers and Kindred Trades is now 93, Borough Road, W., Middlesbrough.

The imports of foreign iron ore at the Prince of Wales Dock at Workington for August amounted to 7,980 tons, compared with 8,000 tons for the previous month.

Messrs. Bolckow, Vaughan & Company, Limited, have received an order from the Birkenhead Corporation for 150 tons of B.S.S. No. 8 high-silicon tramway rails and fishplates.

Messrs. Sir R. Ropner & Company, Limited, shipowners, of West Hartlepool, have placed with Messrs. William Gray & Company, Limited, an order for two cargo steamers.

Imported ball and roller bearings and parts thereof, imported rims for motor and other cycles, and imported cycle parts are all to be marked with an indication of origin, according to reports by the Standing Committee appointed under the Merchandise Marks Act.

The Works Committee of the Mersey Docks and Harbour Board have recommended that the engineer be authorised to provide the necessary railway line, cranes, weighing bridge, etc., at a new berth at the south side of Carriers Dock, Bootle, at a cost of about £23,000.

It is reported from South Wales that work will shortly be commenced on the erection of a new six-mill tinplate works at Gurnos, near Ystalyfera, on behalf of local and London interests. The works will be erected on the land between the Gurnos Road to Ystradgynlais and the Swansea Valley Canal.

The White Star Line state that the new Atlantic liner now being built for them at Belfast by Messrs. Harland and Wolff, Limited, will be of 60,000 tons. She will therefore be the biggest liner in the world, exceeding the "Majestic," at present the largest vessel, by nearly 4,000 tons. The keel of the ship has been laid for three-fourths of her length.

The output from Clyde shipbuilding yards during August reached what is so far the highest monthly total for the year. Twenty-two vessels were launched, with a tonnage of 73,525. The output for the eight months of the year is more than double that of the corresponding period of last year, the figures being 149 vessels of 417,115 tons, compared with 137 ships of 203,175 tons.

The Paris-Lyons Méditerrané Railway, as representative of the French Railways, has placed an order to the value of 50,000,000 German marks with the Benteler Maschinerfabrik, of Bielefeld, for tubes for brake equipment. The contract price is said to be 30 per cent. below that of the International Tube Cartel. The tubes are to be supplied on war reparation account.

According to revised figures issued by the Dominion Bureau of Statistics at Ottawa, the Canadian nickel-copper industry last year produced 1,305,917 tons of ore containing 27,564 tons of copper and 43,574 tons of nickel. The smelters treated 1,350,214 tons of ore and concentrates, and produced 81,488 tons of matte, which contained 51,937,215 lbs. of copper and 79,246,144 lbs. of nickel.

The "Ebbw Vale Works Magazine," commenting on the position at the Company's iron and steel works, states that important conferences have taken place with the representatives of the workmen in order to bring into operation a further extension of the working week at the Bessemer and mill departments of the steelworks, until such time as a large metal mixer is installed to deal with the increased quantity of iron now being made at the furnaces at Victoria, where an additional furnace has been put in blast. The third battery of by-product coke ovens was successfully started up, and coke from the first oven was drawn on July 7 last.

John A. Smeeton, Limited, of 15, Victoria Street, London, S.W.1, inform us that orders for "Collin" patent ladles have recently been received from Harland & Wolff, Limited, Govan Works (one 5-ton capacity and one 25-ton capacity); British Thomson-Houston, Rugby (one 25-ton capacity); Richard Nevill & Company, Llanelly (one 15-ton capacity); C. Akrill & Company, West Bromwich (one 9-ton capacity); Taylor & Farley, Limited, West Bromwich (one 3-ton capacity); John Lysaght, Limited, Wolverhampton (one 12-ton capacity); Morris Motors, Limited, Cowley (one 10-cwt. capacity); and the Combustion Engineering Company, Derby (one each 4-, 6-, and 8-ton, and four carriage ladles of 1-ton and 10-cwt. capacity).

The Home Secretary has appointed a Committee to consider and report what additions to the factory inspectorate are required, whether any changes in its organisation are desirable, and what other measures, if any, can be taken to enable the Factory Department to discharge adequately its existing duties and the further duties foreshadowed by the Government's Factory Bill of 1926. The members of the Committee are:—Lieutenant Colonel Sir Vivian Henderson, M.P. (chairman), Sir Gerald Bellhouse, Mr. R. R. Bannatyne, Mr. Kenneth Lee, Miss H. Martindale, and Mrs. C. D. Rackham. The secretary of the Committee is Mr. L. N. Blake Odgers, of the Home Office, to whom all communications on the subject should be addressed.

## Personal.

Mr. J. F. Innes, works manager at the Vulcan Works, Manchester, of Messrs. John Hetherington & Sons, Limited, textile engineers, has been elected a director in place of Mr. Francis Taylor, recently deceased.

Mr. L. Gerald Firth, general manager of the Firth Sterling Steel Company, McKeesport, Pa., U.S.A., is to spend a month at the works of Messrs. Thomas Firth & Sons, Limited, Sheffield, during an extended European tour.

Sir Robert Hadfield, Bt., head of Messrs. Hadfields, Limited, Sheffield, offered to present a bronze statuary group representing "The Origin of Metallurgy" to the French Academy of Sciences, of which he is a corresponding member. According to a message from Paris, the offer has been accepted.

### Wills.

| | |
|---|---|
| Twemlow, S. P., of Sandbach, Cheshire, managing director of Foden's, Limited | £34,524 |
| Powell, R., of Packwood, Warwick, brassfounder ... ... ... ... | £21,556 |
| Johnson, W. C., founder and late chairman of Messrs. Johnson and Phillips, Limited ... ... ... ... ... | £481,413 |
| Bristow, J., of West Norwood, S.E., director of the United Flexible Metallic Tubing Company, Limited ... ... | £9,133 |
| Towler, J. A., of Ilkley, managing director of the Leeds Engineering and Hydraulic Company, Limited ... ... | £8,909 |

## Company News.

**Singer & Company, Limited.**—The report for the year ended July 31 states that the directors consider the result from the year's working is satisfactory in view of the large capital—£750,000 approximately—utilised in the purchase and equipment of the factory at Coventry Road, Birmingham, being commercially productive for less than six months of the year. The erection of the foundry at Payne's Lane, Coventry, adjacent to the Canterbury Street Works, having proved suitable for all casting requirements, the directors decided to dispose of the original leasehold foundry at Waverley Road, Coventry. The provision previously made of £8,000 to amortise these leaseholds proved insufficient by £1,463, which has been charged against "reserve against properties and plant," reducing the figure to £88,536.

**Wellman Smith Owen Engineering Corporation, Limited.**—The ninth ordinary general meeting was held in London recently. Mr. F. N. Pickett (the chairman) said the company had, in common with all others engaged in the iron and steel industry, suffered from a depression which still afflicted the industry as a whole, although, if a comparison were made between them and companies engaged in similar work, it must be acknowledged that they had suffered less severely than any of their competitors. This was undoubtedly due to the fact that, during the worst period of the slump in the iron and steel industry, their directors designed and developed a line of machinery for the making of weldless steel tubes, and the company was just beginning to reap the benefit of this work. They confidently anticipated a great and growing extension of this particular department of their business. With regard to the future, it seemed certain that, until some protection was afforded the iron and steel industry of this country, the depression was likely to continue. Due to inflation, the steelworks of Germany, France and Belgium were re-equipped after the war with the most modern labour-saving and fuel-economy devices at a cost which, compared with the cost in this country, was almost negligible, and our iron and steel industry was called on to meet competition from these works from their own resources, already seriously depleted by the inroads of taxation.

**R. & W. Hawthorn, Leslie & Company, Limited.**—Mr. C. E. Straker, the chairman, presiding over the annual meeting, held in Newcastle last week, remarked that the shipbuilding and engineering industries, which comprised the activities of the company, were in an intensely depressed condition. Foreign competition was more severe, which brought into stronger light the heavy burdens placed on the producers in this country. It was true that when the rating revision came into operation, some slight relief to their industry might be experienced, but the position called for something much more effective than merely making the burden less direct. Their competitors in other countries were receiving valuable assistance from their Governments with a view of protecting and maintaining the vital industries of their people. Some might feel that the real remedy for the industrial troubles could only be effected by reducing the output capacity so as to balance supply and demand, this being the only apparent counter to the suicidal competition for orders existing at the present time. Unless this were done as the result of a general agreement, there were difficulties in the way of individual companies doing so economically. The practice so largely followed by the Dominions, the Colonies and India, of placing their orders in foreign countries in connection with undertakings and developments which were largely made possible by loans or assistance from this country, required adjusting.

## New Companies.

**Stobie Steel Company, Limited,** Stobie Steelworks, Dunston, Durham.—Capital £10,000.

**Ritzcariton, Limited,** Quadrant House, Regent Street, London, W.1. Capital £100. Engineers, founders, etc.

**Bellanger Bros. (London), Limited,** 5, Bevis Marks, London, E.C.3.—Capital £1,000. Iron and steel merchants, etc. Director: H. Keller.

**T. & J. Connick, Limited.**—Capital £25,000. Iron masters, etc. Directors: Mrs. S. Kelly and Sir S. Kelly, Ballymanock, Holywood, Co. Down.

**Henry Lees & Company, Limited,** 81, Mitchell Street, Glasgow, C.1.—Capital £15,000. Engineers, etc. Directors: W. A. Harvey, J. R. Lumsden and A. W. Biles.

**John Heckie, Son & Company, Limited,** 108, Douglas Street, Glasgow, C.2.—Capital £5,000. Mechanical and electrical engineers, etc. Directors: J. Heckie and M. Caldwell.

**Bolide (Patents), Limited.**—Capital £12,000. Ironfounders, etc. Directors: J. G. de Jetley-Marks, 43, Mapesbury Road, London, N.W.; G. E. R. Price, S. T. Spalding, G. Gee and J. Williams.

**G. Inglis & Company, Limited,** Albert Works, Airdrie.—Capital £10,000 in 5,000 cumulative preference and 5,000 ordinary shares of £1. Iron masters, etc. Directors: H. S. S. Murray, G. Baggesen and J. Inglis.

## Obituary.

Mr. George Laverick, who for several years was manager of the machine shop at the Jarrow works of Messrs. Palmers Shipbuilding and Iron Company, Limited, has died at Low Fell.

Mr. Andrew Lamberton, the founder of the firm of Messrs. Lamberton & Company, Limited, Sunnyside Engine Works, Coatbridge, died at his residence, Blairtummock, Easterhouse, on August 23, in his seventy-sixth year.

Mr. Harry Smith, managing director of Messrs. Abbots Foundry Company, Limited, Falkirk, has died at the age of 73. Mr. Smith was a native of Surrey, and first entered the London office of the firm, being afterwards transferred to Falkirk.

Mr. James G. A. Hart, whose death took place recently, had for the last 25 years been a well-known electrical and mechanical engineer in Leith. He served his apprenticeship to engineering at Woolwich, and was for a time works manager for Messrs. Bruce Peebles & Company.

We regret to announce the death of Mr. James Bowron, chairman of the board of the Gulf States Steel Company, Birmingham, U.S.A. Mr. Bowron was born at Stockton-on-Tees in 1844, and left this country in 1877. He was a regular visitor to the American Foundrymen's Association's Conventions in the eighteen-nineties and early nineteen-hundreds.

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# Iron and Steel Markets.

## Pig-Iron.

**MIDDLESBROUGH.**—Although it has by no means yet returned to anything approaching normal activity, business in the Cleveland iron market is gradually moving in that direction, and the outlook for the autumn months gives reassuring signs of a steady improvement, both in home and export sales. In respect of the last-named section, it is satisfactory to note that shipments of pig-iron from Tees-side to Scotland advanced from 7,101 tons in July to 8,772 tons in August, and foreign exports from 7,338 tons to 8,446 tons, the total shipments of pig-iron to all destinations being 19,008 tons. Home consumers, mostly having depleted stocks, are at last coming into the market, and, though still hesitant and disinclined to commit themselves very far ahead, are within limits prepared to discuss business. Prices continue firmly fixed, with No. 3 Cleveland G.M.B. quoted at 66s. per ton to both home and foreign consumers, and other qualities as follows:—No. 1 foundry, 68s. 6d.; No. 4 foundry, 65s.; No. 4 forge, 64s. 6d.

Buying in the East Coast hematite market is still on a restricted scale, but with the autumn period near at hand makers are anticipating an early return to more active conditions. Prices, also, are a shade steadier, with mixed numbers obtainable at 70s. per ton and No. 1 quality at 6d. extra. On the North-West Coast Bessemer mixed numbers are quoted at 68s. 6d. per ton at works.

**LANCASHIRE.**—Conditions at present existing in the local markets for foundry pig indicate only a poor volume of business passing, the bulk of orders in circulation being for limited tonnages to meet users' current requirements. In these circumstances it may me conceded that sellers have done fairly well to maintain prices at prevailing levels, which may be quoted as follow:—Derbyshire No. 3, 67s. to 67s. 6d.; Staffordshire at a shade below these figures, with Scotch brands from 87s. to 90s., all delivered Manchester or equal.

**THE MIDLANDS.**—Within the past week local ironfounders have been in the market with a view to obtaining supplies over next quarter, but the tonnages involved are not very heavy, and in the main consumers are only buying spot lots to cover their immediate needs. The furnaces are, however, hopeful that this month will see a considerable influx of business, and consequently refrain from accepting orders at below current figures. Quotations therefore rule as follows: Derbyshire No. 3, 59s. to 60s.; Northamptonshire, 55s. to 56s.; and North Staffordshire, 60s., f.o.t.

**SCOTLAND.**—In some quarters a more hopeful feeling is expressed in regard to the outlook for pig-iron, although so far this has not been substantiated by any increased demand. Prices generally are unchanged, but consumers in one or two instances are inclined to make inquiries for larger tonnages than they have been considering, though buying more or less from hand to mouth. The light-castings section is only moderately employed, but now that the wages question with the men has been settled, there may be an expansion in business.

## Finished Iron.

South Staffordshire manufacturers report little improvement in demand from the local works for crown and the cheaper grades of iron, although there is a somewhat better inquiry and a few more orders are developing for marked bars, which are quoted at £12 at makers' works. The local mills have to contend with keen competition from Derbyshire and Lancashire for crown iron, and there is nothing near sufficient business developing to keep the plants regularly occupied. Consequently prices are still being cut to a considerable extent, varying from £9 up to £9 15s. for crown quality and from £8 12s. 6d. to £8 17s. 6d. for nut and bolt iron. The foreign product is now quoted at between £6 17s. 6d. and £7, delivered locally, whereas the cheapest nut and bolt iron in the market here would be £8 12s. 6d.

## Steel.

St. Leger week, always a great festival in the North, has had a quietening effect upon business in the Sheffield steel market, but there are a few signs that autumn business may show a marked improvement. Already inquiries are fairly numerous. Business in acid billets is a little better, but basic qualities remain much as they were previously. No material is being bought in any but small quantities at the present moment. Fortunately for British producers, there is little prospect of Continental steel prices falling to the low figures which ruled some time ago, and when buyers of the cheaper steels become convinced of this, they will doubtless resume forward buying on the old scale. Tinplate buyers are still rather cautious, but the tone is better, and regular trade may now reasonably be looked for; quotations may be called steady at round 18s. to 18s. 3d. basis, net cash, f.o.b. Welsh ports.

## Scrap.

After a lengthened period of comparative stagnation, the markets for foundry scrap metals give promise of more active conditions as the autumn advances. In the North-Eastern area the Tees-side foundries seem to be becoming rather busier, and a few parcels of heavy cast iron are changing hands on the basis of 60s. per ton for ordinary quality and 65s. for machinery quality in handy pieces. In the Black Country districts also the position of cast-iron scrap has improved somewhat, and prices are firmer; 65s. delivered is offered for heavy machinery cast-iron scrap, broken into cupola sizes, and 52s. 6d. delivered for light cast-iron scrap. In Scotland machinery cast-iron scrap is still quoted at 65s. to 66s. for material in pieces not exceeding 1 cwt., and heavy ordinary cast iron at 60s. to 62s. 6d. Old cast-iron railway chairs are 64s. to 65s., and light cast iron 57s. 6d. The above prices are all per ton, delivered f.o.t. consumers' works.

## Metals.

**Copper.**—The steady appreciation of values of warrant copper continues practically unchecked from week to week, a position fully justified by the very favourable statistical returns and the growing expansion of European demand. Prices have wavered but little, and have moved only in a small compass. Stocks, invisible as well as visible, are at a low level, and the lately increased productivity has hardly brought the influx of fresh supplies up to the level of current demand. It is likely that the decrease in stocks will continue in spite of the fact that they are already low enough to cause considerable anxiety.

Closing quotations are:—

*Cash.*—Thursday, £62 16s. 3d. to £62 17s. 6d.; Friday, £62 16s. 3d. to £62 18s. 9d.; Monday, £62 16s. 3d. to £62 18s. 9d.; Tuesday, £62 15s. to £62 16s. 3d.; Wednesday, £62 16s. 3d. to £62 17s. 6d.

*Three Months.*—Thursday, £62 6s. 3d. to £63 7s. 6d.; Friday, £63 6s. 3d. to £63 7s. 6d.; Monday, £63 6s. 3d. to £63 8s. 9d.; Tuesday, £63 5s. to £63 6s. 3d.; Wednesday, £63 6s. 3d. to £63 7s. 6d.

**Tin.**—In spite of an occasional relapse in quotations, movements in standard cash tin present a more favourable aspect than for some time past, with a tendency to an early improvement in values. Growing production is causing considerably less fear than was recently the case, and many people consider that it should almost have reached its zenith by now. The consumption continues to give promise of further expansion, and while the Continental and American requirements still prove satisfactory, the Welsh tinplate industry is holding out fairly good hopes of future improvement, and it may be anticipated that sales in this quarter will expand.

Official closing prices:—

*Cash.*—Thursday, £211 5s. to £211 10s.; Friday, £210 15s to £210 17s. 6d.; Monday, £209 17s. 6d. to £210; Tuesday, £209 12s. 6d. to £209 17s. 6d.; Wednesday, £210 12s. 6d. to £210 17s. 6d.

*Three Months.*—Thursday, £209 5s. to £209 10s.; Friday, £209 2s. 6d. to £209 5s.; Monday, £208 5s. to £208 10s.; Tuesday, £208 5s. to £208 10s.; Wednesday, £209 10s. to £209 12s. 6d.

**Spelter.**—Market operations in ordinary spelter during the current week have been on a more restricted scale than of late, and the position seems to have returned to its former humdrum state. Steadiness has been the rule, and buying and selling has not been free. It appears that the increase in output has been checked, which is a favourable point in the situation for holders. As the galvanising industry here shows improvement, more activity is probable.

Daily quotations are:—

*Ordinary.*—Thursday, £24 16s. 3d.; Friday, £24 12s. 6d.; Monday, £24 13s. 9d.; Tuesday, £24 15s.; Wednesday, £24 13s. 9d.

**Lead.**—Demand for soft foreign pig on home account is fairly well maintained, with values again slightly on the up-grade. Sellers, though readily come forward to meet the demand. The situation, however, tends to indicate a further increase, but, as rising prices are bound to have a strong influence on the activities of producers, it is not likely that the advance will be much greater.

Closing prices:—

*Soft Foreign Prompt.*—Thursday, £22 5s.; Friday, £22 1s. 3d.; Monday, £22 2s. 6d.; Tuesday, £22 5s.; Wednesday, £22 2s. 6d.

## The Machine Tool and Engineering Exhibition.

(*Continued from page* 192.)

by a patented ballast resistance. Two tempering ovens are being shown, one using oil and the other air, as the quenching medium. Automatic temperature control is a feature of these furnaces.

**Brayshaw Furnaces & Tools, Limited**, Manchester.—The most striking exhibit on this stand, if not in the whole exhibition, is an automatic conveyor furnace. The trucks containing the articles to be heat-treated are charged into the furnace, pass through the hot chamber, tipped on leaving the furnace to discharge its contents and then returned under the furnace to the entrance to be reloaded and again charged without any serious loss of heat. The rate of passage through the furnace can be adjusted within wide limits. The little trucks which form the furnace floor are returned from the discharging end to the loading end so quickly that their heat is largely maintained and economies of fuel naturally result.

### A FEW SPECIALISED EXHIBITS.

**Langham Engineering Company**, Slough.—This firm is showing working examples of slow-speed direct motor-driving units, comprising an electric motor with a gear box filled integrally with one end shield and containing a silent alloy steel reduction gear running in oil. These units are shown coupled to various industrial drives. Of special interest is the 5 h.p. unit running at 120 r.p.m., fitted with a reversing gear box giving its output at 60 r.p.m., the motor running continuously at 1,500 r.p.m. in one direction.

**Clifton & Baird, Limited**, Johnstone.—This firm specialises in metal-sawing machines and the range shown, includes high-speed cold-sawing, hot-sawing, band, friction and automatic saw-sharpening machines.

**R. A. Lister & Company, Limited**, Dursley.—On this stand five types of trucks are shown, of which the most interesting is the elevating platform truck. A swivelling tipping truck is another which merits attention, as it permits of tipping at any angle.

### VICES.

**C. & J. Hampton, Limited**, Sheffield.—Six types of vices are shown which cover the major requirements of the mining and metallurgical industries. Whilst cast iron is normally used, this maker has not hesitated to incorporate malleable castings for the highly stressed parts and in some cases has made the complete tool from steel.

**Institute of Metals.**—The new half-yearly volume of the Journal of the Institute contains an account of the proceedings at the twentieth annual general meeting.

**Cementation of Iron.**—A Japanese investigator, Mr. M. Imatomi, has carried out some experiments of producing cementation of electrolytic iron with a mixture of benzol and nitrogen at temperatures up to 850 deg. By passing a current of the mixture over the incandescent iron at the rate of 1,000 cub. cm. per hour for 1, 2 and 3 hours respectively, he increased the weight of the specimen by 1.7 per cent., 2.4 per cent., and 3.2 per cent. respectively. He reports to have produced by this means iron so hard that it scratched glass.

# The Key to Better Castings

# Capponfield is open again

The well-known Capponfield brand of South Staffordshire Pig Iron is again on the market after a lapse of many years.
A very careful system of operation, including selection, grading and analysis, has been instituted enabling Bradley's to offer three grades of Pig Iron to meet the full requirements of the modern foundryman.
The exact chemical composition of each cast and strict uniformity of fracture will be supplied.
Quality castings need quality Pig Iron—Capponfield quality enables you to produce better castings at less cost.

3 Perfect Grades

**Capponfield H.B.**
(HOT BLAST)

**Capponfield W.B.**
(WARM BLAST)

**Capponfield C.B.**
(COLD BLAST)

Bradley's CAPPONFIELD PIG IRON

"Capponfield Quality"

All Capponfield Irons are direct blast furnace products. Bradley's well-known Refined Irons are made at the Darlaston Works.

## BRADLEY & FOSTER LIMITED

CAPPONFIELD AND DARLASTON, STAFFS
(All communications should be addressed to Darlaston).

TELEPHONE: DARLASTON 16 (Private Branch Exchange). TELEGRAMS: BRADLEY'S, DARLASTON

# WEEKLY PRICE CURRENT.

## COPPER.

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 62 | 16 | 3 |
| Three months | 63 | 6 | 3 |
| Electrolytic | 69 | 0 | 0 |
| Tough | 65 | 5 | 0 |
| Best selected | 65 | 5 | 0 |
| Sheets | 94 | 0 | 0 |
| India | 76 | 15 | 0 |
| Wire bars | 69 | 5 | 0 |
| Do. September | 69 | 5 | 0 |
| Do. October | 69 | 5 | 0 |
| Ingot bars | 69 | 5 | 0 |
| H.C. Wire rods | 73 | 5 | 0 |
| Off. av. cash, August | 62 | 10 | 2 17/24 |
| Do. 3 mths., August | 62 | 18 | 11 15/24 |
| Do., Sttlmnt., August | 62 | 10 | 4 1/12 |
| Do., Electro, August | 69 | 0 | 0 |
| Do., B.S., August | 65 | 14 | 2 |
| Aver. spot price, copper, Aug. | 62 | 10 | 2½ |
| Do., Wire bars, August | 69 | 5 | 0 |
| Solid drawn tubes | | | 13½d. |
| Brazed tubes | | | 13½d. |
| Wire | | | 10d. |

## BRASS.

| | |
|---|---|
| Solid drawn tubes | 11½d. |
| Brazed tubes | 13½d. |
| Rods, drawn | 10½d. |
| Rods, extd. or rlld. | 7½d. |
| Sheets to 10 w.g. | 10½d. |
| Wire | 9½d. |
| Rolled metal | 9½d. |
| Yellow metal rods | 7½d. |
| Do. 4 × 4 Squares | 8d. |
| Do. 4 × 3 Sheets | 8½d. |

## TIN.

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 210 | 12 | 6 |
| Three months | 209 | 10 | 3 |
| English | 209 | 15 | 0 |
| Bars | 209 | 15 | 0 |
| Straits | 213 | 5 | 0 |
| Australian | 211 | 0 | 0 |
| Eastern | 212 | 0 | 0 |
| Banca | 217 | 5 | 0 |
| Off. av. cash, August | 212 | 19 | 10 7/11 |
| Do., 3 mths., August | 210 | 0 | 2 3/22 |
| Do., Sttlmt., August | 212 | 19 | 1 4/11 |
| Aver. spot, August | 212 | 19 | 10½ |

## SPELTER.

| | £ | s. | d. |
|---|---|---|---|
| Ordinary | 24 | 13 | 9 |
| Remelted | 23 | 0 | 0 |
| Hard | 19 | 10 | 0 |
| Electro 99.9 | 28 | 5 | 0 |
| English | 25 | 2 | 6 |
| India | 21 | 5 | 0 |
| Zinc dust (Nom.) | 35 | 5 | 0 |
| Zinc ashes | 7 | 15 | 0 |
| Off. aver., August | 24 | 12 | 6 15/44 |
| Aver., spot, August | 24 | 10 | 9½ |

## LEAD.

| | £ | s. | d. |
|---|---|---|---|
| Soft foreign ppt. | 22 | 2 | 6 |
| English | 23 | 10 | 0 |
| Off. average, August | 21 | 12 | 7 1/11 |
| Average spot, August | 21 | 12 | 8 |

## ZINC SHEETS, &c.

| | £ | s. | d. |
|---|---|---|---|
| Zinc sheets, English | 33 | 0 | 0 |
| Do. V.M. ex whf. | 31 | 5 | 0 |
| Rods | 39 | 0 | 0 |
| Boiler plates | 29 | 0 | 0 |
| Battery plates | 30 | 10 | 0 |

## ANTIMONY.

| | £ | s. | d. |
|---|---|---|---|
| Special brands, Eng. | 59 | 0 | 0 |
| Chinese | 39 | 0 | 0 |
| Crude | 33 | 10 | 0 |

## QUICKSILVER.

| | £ | s. | d. |
|---|---|---|---|
| Quicksilver | 23 | 15 | 0 |

## FERRO-ALLOYS AND STEEL-MAKING METALS.

| | |
|---|---|
| Ferro-silicon— | |
| 25% | £7 17 6 |
| 45/50% | £12 0 0 |
| 75% | £19 0 0 |
| Ferro-vanadium— | |
| 35/50% | 14/- lb. Va. |
| Ferro-molybdenum— | |
| 70/75% c. free | 4/3 lb. Mo. |
| Ferro-titanium— | |
| 23/25% carbonless | 1/2 lb. |
| Ferro-phosphorus, 20/25% | £18 0 0 |
| Ferro-tungsten— | |
| 80/85%, c. fr. | 1/3 lb. |
| Tungsten metal powder— | |
| 98/99% | 1/7 to 1/7½ lb. |
| Ferro-chrome— | |
| 2/4% car. | £30 0 0 |
| 4/6% car. | £21 7 6 |
| 6/8% car. | £20 12 6 |
| 8/10% car. | £20 0 0 |
| Ferro-chrome— | |
| Max. 2% car. | £32 15 0 |
| Max. 1% car. | £36 17 6 |
| Max. 0.70% car. | £41 0 0 |
| 70% carbonless | 1/- lb. |
| Nickel—99%, cubes or pellets | £175 0 0 |
| Ferro-cobalt | 9/- lb. |
| Aluminium 98/99% | £98 0 0 |
| Metallic chromium— | |
| 96/98% | 2/7 lb. |
| Ferro-manganese (net)— | |
| 76/80%, loose | £13 15 0 |
| 76/80%, packed | £14 15 0 |
| 76/80%, export | £13 15 0 |
| Metallic manganese— | |
| 94/96%, carbonless | 1/6 lb. |

Per ton unless otherwise stated.

## HIGH-SPEED TOOL STEEL.

| | |
|---|---|
| Finished bars, 14% tungsten | £0 2 3 |
| Finished bars, 18% tungsten | £0 2 9 |

Per lb. net, d/d buyers' works.

| | |
|---|---|
| Extras— | |
| Rounds and squares, 3 in. and over | 4d. lb. |
| Rounds and squares, under ½ in. to ¼ in. | 3d. lb. |
| Do., under ¼ in. to 1/8 in. | 1/- lb. |
| Flats, ½ in. × ¼ in. to under 1 in. × ¼ in. | 3d. lb. |
| Do., under ½ in. × ¼ in. | 1/-lb. |
| Bevels of approved sizes and sections | 6d. lb. |

Bars cut to length, 10% extra.

| | |
|---|---|
| Scrap from high-speed tool steel— | |
| Scrap pieces | 3d. |
| Turnings and swarf | 1d. |

Per lb. net, d/d steel makers' works.

## SCRAP.

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| South Wales— | | | | | | |
| Hvy. steel | 3 | 7 | 0 | to 3 | 8 | 6 |
| Bundled steel and shrngs. | 3 | 2 | 6 | to 3 | 7 | 6 |
| Mixed iron and steel | 3 | 0 | 0 | to 3 | 2 | 0 |
| Heavy cast iron | 2 | 16 | 0 | to 2 | 18 | 0 |
| Good machinery for foundries | | | | 3 | 2 | 6 |
| Cleveland— | | | | | | |
| Heavy steel | | | | 2 | 15 | 0 |
| Steel turnings | | | | 2 | 7 | 6 |
| Cast iron borings | | | | 2 | 4 | 0 |
| Heavy forge | | | | 3 | 10 | 0 |
| Bushelled scrap | | | | 3 | 0 | 0 |
| Cast-iron scrap | | | | 3 | 2 | 6 |
| Lancashire— | | | | | | |
| Cast-iron scrap | | | | 3 | 0 | 0 |
| Hvy. wrought | | | | 2 | 17 | 6 |
| Steel turnings | | | | 2 | 2 | 6 |

London—Merchants' buying prices delivered yard.

| | | | |
|---|---|---|---|
| Copper (clean) | 52 | 0 | 0 |
| Brass | 37 | 0 | 0 |
| Lead (less usual draft) | 18 | 0 | 0 |
| Tea lead | 16 | 0 | 0 |
| Zinc | 15 | 0 | 0 |
| New aluminium cuttings | 66 | 0 | 0 |
| Braziery copper | 47 | 0 | 0 |
| Gunmetal | 47 | 0 | 0 |
| Hollow pewter | 150 | 0 | 0 |
| Shaped black pewter | 105 | 0 | 0 |

## PIG-IRON.

*(f.o.t. unless otherwise stated.)*

| | |
|---|---|
| N.E. Coast— | |
| Foundry No. 1 | 68/6 |
| Foundry No. 3 | 66/- |
| Foundry No. 4 | 65/- |
| Forge No. 4 | 64/6 |
| Hematite No. 1 | 70/- |
| Hematite M/Nos. | 70/- |
| N.W. Coast— | |
| Hem. M/Nos. d/d Glas. | 78/6 |
| ,, d/d Birm. | 86/- |
| Midlands— | |
| Staffs. common* | 67/6 |
| ,, No. 4 forge | 56/- |
| ,, No. 3 fdry. | 59/6 |
| Shrops. basic | — |
| ,, Cold blast, ord.* | — |
| ,, ,, roll iron* | — |
| * d/d Birmingham. | |
| Northants forge | 51/6 |
| ,, fdry. No. 3 | 55/- |
| Derbyshire forge | 59/- |
| ,, fdry. No. 3 | 59/6 |
| ,, basic | 60/- |
| Scotland— | |
| Foundry No. 1 | 75/- |
| ,, No. 3 | 70/- |
| Hem. M/Nos. | 74/- |
| Sheffield (d/d district)— | |
| Derby forge | 61/6 |
| ,, fdry. No. 3 | 64/- |
| Lincs. forge | 62/6 |
| ,, fdry. No. 3 | 64/- |
| E.C. hematite | 78/6 |
| W.C. hematite | 84/- |
| Lincs. (at furnaces)— | |
| Forge No. 4 | 58/- |
| Foundry No. 3 | 59/6 |
| Basic | 59/- |
| Lancashire (d/d sq. Man.)— | |
| Derby forge | — |
| ,, fdry. No. 3 | 67/6 |
| Northants foundry No. 3 | — |
| Dalzell, No. 3 (special) | 100/- to 102/6 |
| Summerlee, No. 3 | 87/- to 90/- |
| Glengarnock, No. 3 | 87/- to 90/- |
| Gartsherrie, No. 3 | 87/- to 90/- |
| Monkland, No. 3 | 87/- to 90/- |
| Shotts, No. 3 | 87/- to 90/- |

## FINISHED IRON AND STEEL.

*Usual District deliveries for iron; delivered consumers' station for steel.*

| Iron— | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Bars (cr.) nom. | 9 | 10 | 0 | to 10 | 15 | 0 |
| Nut and bolt iron | 8 | 12 | 6 | to 8 | 17 | 6 |
| Hoops | | | | 11 | 10 | 0 |
| Marked bars (Staffs.) f.o.t. | | | | 12 | 0 | 0 |
| Gas strip | | | | 11 | 10 | 0 |
| Bolts and nuts, ½ in. × 4 in. | | | | 15 | 5 | 0 |
| Steel— | | | | | | |
| Ship plates | 8 | 7 | 6 | to 8 | 12 | 6 |
| Boiler plts. | | | | 10 | 10 | 0 |
| Chequer plts. | | | | 10 | 12 | 6 |
| Angles | | | | 7 | 17 | 6 |
| Tees | | | | 8 | 17 | 6 |
| Joists | | | | 7 | 17 | 6 |
| Rounds and squares, 3 in. to 5½ in. | | | | 8 | 17 | 6 |
| Rounds under 3 in. to ½ in. (Untested) | | | | 7 | 15 | 0 |
| | | | | and upwards | | |
| Flats, over 5 in. wide and up | | | | 8 | 7 | 6 |
| Flats, 5 in. to 1½ in. | | | | 7 | 17 | 6 |
| Rails, heavy | | | | 8 | 10 | 0 |
| Fishplates | | | | 12 | 10 | 0 |
| Hoops (Staffs.) | | | | 10 | 0 | 0 |
| Black sheets, 24g. | | | | 10 | 0 | 0 |
| Galv. cor. shts., 24g. | | | | 13 | 10 | 0 |
| Galv. fencing wire 8g. plain | | | | 12 | 10 | 0 |
| Billets, soft | 6 | 2 | 6 | to 6 | 15 | 0 |
| Billets, hard | 7 | 2 | 6 | to 7 | 12 | 6 |
| Sheet bars | | | | 6 | 0 | 0 |
| Tin bars | | | | 6 | 0 | 0 |

## PHOSPHOR BRONZE.

| | Per lb. basis. |
|---|---|
| Strip | 1 2½ |
| Sheet to 10 w.g. | 1 3 |
| Wire | 1 3½ |
| Rods | 1 3 |
| Tubes | 1 7½ |
| Castings | 1 2 |

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

## NICKEL SILVER, &c.

| | per lb. |
|---|---|
| Ingots for raising | 9d. to 1/3 |
| Rolled— | |
| To 9 in. wide | 1/3 to 1/9 |
| To 12 in. wide | 1/3½ to 1/9½ |
| To 15 in. wide | 1/3½ to 1/9½ |
| To 18 in. wide | 1/4 to 1/10 |
| To 21 in. wide | 1/4½ to 1/10½ |
| To 25 in. wide | 1/5 to 1/11 |
| Ingots for spoons and forks | 9d. to 1/5½ |
| Ingots rolled to spoon size | 1/- to 1/8½ |
| Wire round— | |
| 3/0 to 10 G. | 1/6½ to 2/1½ |

with extras according to gauge.

## AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

| | Dols. |
|---|---|
| No. 2X foundry, Phila. | 20.26 |
| No. 2 foundry, Valley | 16.50 |
| No. 2 foundry, Birm. | 16.25 |
| Basic | 17.76 |
| Bessemer | 18.76 |
| Malleable | 18.76 |
| Grey forge | 18.01 |
| Ferro-mang. 80% d/d | 105.00 |
| O.-h. rails, h'y at mill | 43.00 |
| Bess billets | 32.00 |
| O.-h. billets | 32.00 |
| O.-h. sheet bars | 32.00 |
| Wire rods | 42.00 |
| | Cents. |
| Iron bars, Phila. | 2.12 |
| Steel bars | 1.90 |
| Tank plates | 1.90 |
| Beams, etc. | 1.90 |
| Skelp, grooved steel | 1.90 |
| Skelp, sheared steel | 1.90 |
| Steel hoops | 2.20 |
| Sheets, black, No. 24 | 2.65 |
| Sheets, galv., No. 24 | 3.40 |
| Sheets, blue an'l'd., 9 and 10 | 2.00 |
| Wire nails | 2.55 |
| Plain wire | 2.40 |
| Barbed wire, galv. | 3.20 |
| Tinplates, 100 lb. box | $5.25 |

## COKE (at ovens).

| | |
|---|---|
| Welsh foundry | — |
| ,, furnace | 19/- to 21/- |
| Durham and North. | |
| ,, foundry | 14/- to 14/6 |
| ,, furnace | 14/- |
| Midlands, foundry | — |
| ,, ,, furnace | 12/- |

## TINPLATES.

f.o.b. Bristol Channel ports.

| | | |
|---|---|---|
| I.C. Cokes | 20×14 box | 18/- to 18/3 |
| ,, | 28×20 ,, | 36/3 |
| ,, | 20×10 ,, | 27/- |
| ,, | 18¾×14 ,, | 18/9 |
| C.W. | 20×14 ,, | 16/- |
| ,, | 28×20 ,, | 33/6 |
| ,, | 20×10 ,, | 22/- |
| ,, | 18¾×14 ,, | 15/9 |
| Terneplates | 28×20 | 33/6 per box basis f.o.b. |

## SWEDISH IRON.

| | |
|---|---|
| Bars, hammered, | £17 10 0 to £18 10 0 |
| Rolled Ord. | £15 0 0 to £15 10 0 |
| Nail rods | £15 7 6 to £15 15 0 |
| Keg. steel nom. | £32 to £33 |
| Faggot steel nom. | £22 to £25 |
| Blooms, according to quality | £8 to £12 |
| Pig-iron | £5 15 0 to £6 0 0 |

all f.o.b. Gothenburg

### TUBES AND FITTINGS.

Up to and incl. 6 in.

| | *Tubes.* | *Fittings.* |
|---|---|---|
| Gas .. .. | 67½% .. | .. 50% |
| Water .. .. | 63¾% .. | .. 45% |
| Steam .. .. | 60% .. | .. 40% |

W.I. 10% extra.

### DAILY FLUCTUATIONS.

**Standard Copper** (cash).

| | £ s. d. | |
|---|---|---|
| Sept. 6 .. | 62 16 3 dec. | 5/- |
| „ 7 .. | 62 16 3 No change | |
| „ 10 .. | 62 16 3 „ „ | |
| „ 11 .. | 62 15 0 dec. | 1/3 |
| „ 12 .. | 62 16 3 inc. | 1/3 |

**Electrolytic Copper.**

| | £ s. d. | |
|---|---|---|
| Sept. 6 .. | 68 15 0 | No change |
| „ 7 .. | 68 15 0 „ | „ |
| „ 10 .. | 68 15 0 „ | „ |
| „ 11 .. | 68 15 0 „ | „ |
| „ 12 .. | 69 0 0 inc. | 5/- |

**Standard Tin** (cash).

| | £ s. d. | |
|---|---|---|
| Sept. 6 .. | 211 5 0 inc. | 12/6 |
| „ 7 .. | 210 15 0 dec. | 10/- |
| „ 10 .. | 209 17 6 „ | 17/6 |
| „ 11 .. | 209 12 6 „ | 5/- |
| „ 12 .. | 210 12 6 inc. | 20/- |

**Tin** (English ingots).

| | £ s. d. | |
|---|---|---|
| Sept. 6 .. | 210 5 0 inc. | 10/- |
| „ 7 .. | 208 15 0 dec. | 30/- |
| „ 10 .. | 208 10 0 „ | 5/- |
| „ 11 .. | 207 15 0 „ | 15/- |
| „ 12 .. | 209 15 0 inc. | 40/- |

**Zinc Sheets** (English).

| | £ s. d. | |
|---|---|---|
| Sept. 6 .. | 33 0 0 | No change |
| „ 7 .. | 33 0 0 „ | „ |
| „ 10 .. | 33 0 0 „ | „ |
| „ 11 .. | 33 0 0 „ | „ |
| „ 12 .. | 33 0 0 „ | „ |

**Spelter** (ordinary).

| | £ s. d. | |
|---|---|---|
| Sept. 6 .. | 24 16 3 dec. | 1/3 |
| „ 7 .. | 24 12 6 dec. | 3/9 |
| „ 10 .. | 24 13 9 inc. | 1/3 |
| „ 11 .. | 24 15 0 inc. | 1/3 |
| „ 12 .. | 24 13 9 dec. | 1/3 |

**Lead** (English).

| | £ s. d. | |
|---|---|---|
| Sept. 6 .. | 23 10 0 dec. | 5/- |
| „ 7 .. | 23 5 0 „ | 5/- |
| „ 10 .. | 23 10 0 inc. | 5/- |
| „ 11 .. | 23 10 0 No change | |
| „ 12 .. | 23 10 0 „ | „ |

### AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS).

| | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Yearly average. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| 1897 ..... | 6 0 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 0 0 | 6 0 0 | 6 3 9 |
| 1898 ..... | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 10 0 | 6 10 0 | 6 2 11 |
| 1899 ..... | 6 10 0 | 6 15 0 | 6 15 0 | 6 15 0 | 7 0 0 | 7 0 0 | 7 10 0 | 7 10 0 | 8 10 0 | 9 0 0 | 9 0 0 | 9 10 0 | 7 12 11 |
| 1900 ..... | 10 0 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 15 0 | 10 15 0 | 10 5 0 | 10 5 0 | 10 5 0 | 9 10 0 | 8 15 0 | 8 15 0 | 10 1 3 |
| 1901 ..... | 8 0 0 | 7 10 0 | 7 5 0 | 7 0 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 15 0 | 6 15 0 | 6 15 0 | 6 15 0 | 6 17 11 |
| 1902 ..... | 7 0 0 | 6 10 0 | 6 15 0 | 6 15 0 | 6 15 0 | 6 10 0 | 6 10 0 | 6 15 0 | 6 15 0 | 6 15 0 | 6 10 0 | 6 10 0 | 6 13 4 |
| 1903 ..... | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 7 0 | 6 5 0 | 6 9 4 |
| 1904 ..... | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 10 0 | 6 5 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 0 0 | 6 2 11 |
| 1905 ..... | 6 5 0 | 6 5 0 | 6 0 0 | 5 17 6 | 5 15 0 | 5 15 0 | 5 15 0 | 5 15 0 | 6 0 0 | 6 5 0 | 6 15 0 | 6 15 0 | 6 1 10½ |
| 1906 ..... | 7 0 0 | 7 5 0 | 7 5 0 | 7 5 0 | 6 17 6 | 6 15 0 | 6 12 6 | 6 10 0 | 6 10 0 | 6 12 6 | 6 16 3 | 7 3 9 | 6 17 8½ |
| 1907 ..... | 7 3 9 | 7 5 0 | 7 5 0 | 7 5 0 | 7 5 0 | 7 7 6 | 7 5 0 | 7 7 6 | 7 7 6 | 7 7 6 | 7 7 6 | 7 5 0 | 7 5 11 |
| 1908 ..... | 7 2 6 | 7 0 0 | 7 0 0 | 7 0 0 | 6 15 0 | 6 7 6 | 6 5 0 | 6 2 6 | 6 2 6 | 6 2 6 | 6 2 6 | 6 0 0 | 6 10 0 |
| 1909 ..... | 6 0 0 | 6 0 0 | 6 0 0 | 5 17 6 | 6 0 0 | 6 0 0 | 6 0 0 | 5 17 6 | 6 0 0 | 6 2 6 | 6 2 6 | 5 17 6 | 5 19 9½ |
| 1910 ..... | 6 2 6 | 6 3 4½ | 6 7 6 | 6 7 6 | 6 7 6 | 6 7 6 | 6 6 6 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 7 |
| 1911 ..... | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 5 0 | 6 10 0 | 6 12 6 | 6 16 6 | 6 7 0 |
| 1912 ..... | 6 18 9 | 7 1 10 | 7 2 6 | 7 8 9 | 7 18 0 | 8 0 7 | 8 2 6 | 8 3 6 | 8 5 0 | 8 6 3 | 8 7 6 | 8 8 9 | 7 17 0 |
| 1913 ..... | 8 11 6 | 8 10 7½ | 8 10 0 | 8 8 1½ | 8 2 0 | 8 0 0 | 7 17 6 | 7 11 6 | 7 8 9 | 7 5 6 | 6 18 1½ | 6 17 6 | 7 16 9 |
| 1914 ..... | 6 17 6 | 6 15 7½ | 6 12 6 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 7 11 10½ | 8 0 0 | 7 12 6 | 7 5 7½ | 7 6 3 | 7 1 0 |
| 1915 ..... | 7 11 6 | 8 5 11 | 8 8 9 | 9 6 0 | 10 3 2 | 10 19 2 | 11 12 6 | 11 13 1½ | 11 13 9 | 11 14 3 | 12 1 10½ | 13 0 9 | 10 6 0 |
| 1916 ..... | 13 7 6 | 13 10 8 | 13 12 9½ | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 3 9½ |
| 1917 ..... | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 | 13 15 0 |
| 1918 ..... | 13 15 0 | 13 17 3 | 13 17 6 | 13 17 6 | 13 17 6 | 13 17 6 | 13 17 6 | 14 15 0 | 14 15 0 | 14 15 0 | 14 15 0 | 14 15 0 | 14 4 5½ |
| 1919 ..... | 15 10 0 | 16 5 0 | 17 15 0 | 17 15 0 | 20 15 0 | 21 0 0 | 21 0 0 | 22 0 0 | 22 0 0 | 22 0 0 | 22 7 6 | 22 12 6 | 20 1 8 |
| 1920 ..... | 24 7 6 | 24 10 0 | 25 10 0 | 27 10 0 | 29 5 0 | 31 0 0 | 31 10 0 | 31 10 0 | 31 10 0 | 31 10 0 | 31 10 0 | 29 7 6 | 29 1 8 |
| 1921 ..... | 26 17 3 | 25 0 0 | 23 0 0 | 21 0 0 | 19 0 0 | 18 5 0 | 16 0 0 | 16 0 0 | 15 14 0 | 14 0 0 | 13 6 8 | 13 0 0 | 19 4 5 |
| 1922 ..... | 13 0 0 | 12 3 9 | 11 14 0 | 11 11 10½ | 11 5 0 | 11 3 6 | 11 2 6 | 11 5 0 | 10 17 2½ | 10 16 3 | 10 13 0 | 10 12 6 | 11 7 0½ |
| 1923 ..... | 10 16 10½ | 11 3 1½ | 12 2 6 | 12 8 9 | 12 11 6 | 12 1 3 | 11 15 11½ | 11 15 0 | 11 15 0 | 11 15 0 | 12 13 6 | 12 8 3 | 11 18 10½ |
| 1924 ..... | 12 9 6 | 12 10 0 | 12 10 0 | 12 15 7½ | 12 17 6 | 12 17 6 | 12 17 6 | 12 17 6 | 12 17 6 | 12 14 0 | 12 12 6 | 12 12 6 | 12 14 3½ |
| 1925 ..... | 12 12 6 | 12 12 6 | 12 12 6 | 12 12 6 | 12 12 6 | 12 7 6 | 12 7 6 | 12 7 6 | 12 4 6 | 11 18 6 | 11 13 9 | 11 13 0 | 12 6 2½ |
| 1926 ..... | 11 7 9½ | 11 5 0 | 11 5 0 | 11 5 0 | 11 3 9 | 11 3 9 | 11 5 0 | 12 0 0 | 13 0 0 | * | 15 7 6 | 12 10 0 | 12 0 2 |
| 1927 ..... | 12 6 3 | 12 2 6 | 11 14 0 | 11 0 0 | 10 18 9 | 10 13 6 | 10 12 6 | 10 5 0 | 9 16 0 | 9 15 0 | 9 13 9 | 9 12 9 | 10 14 2 |
| 1928 ..... | 9 12 6 | 9 12 6 | 9 11 0 | 9 10 0 | 9 8 4 | 9 5 0 | 9 5 0 | 9 5 0 | — | — | — | — | — |

* No quotations available owing to strike.


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